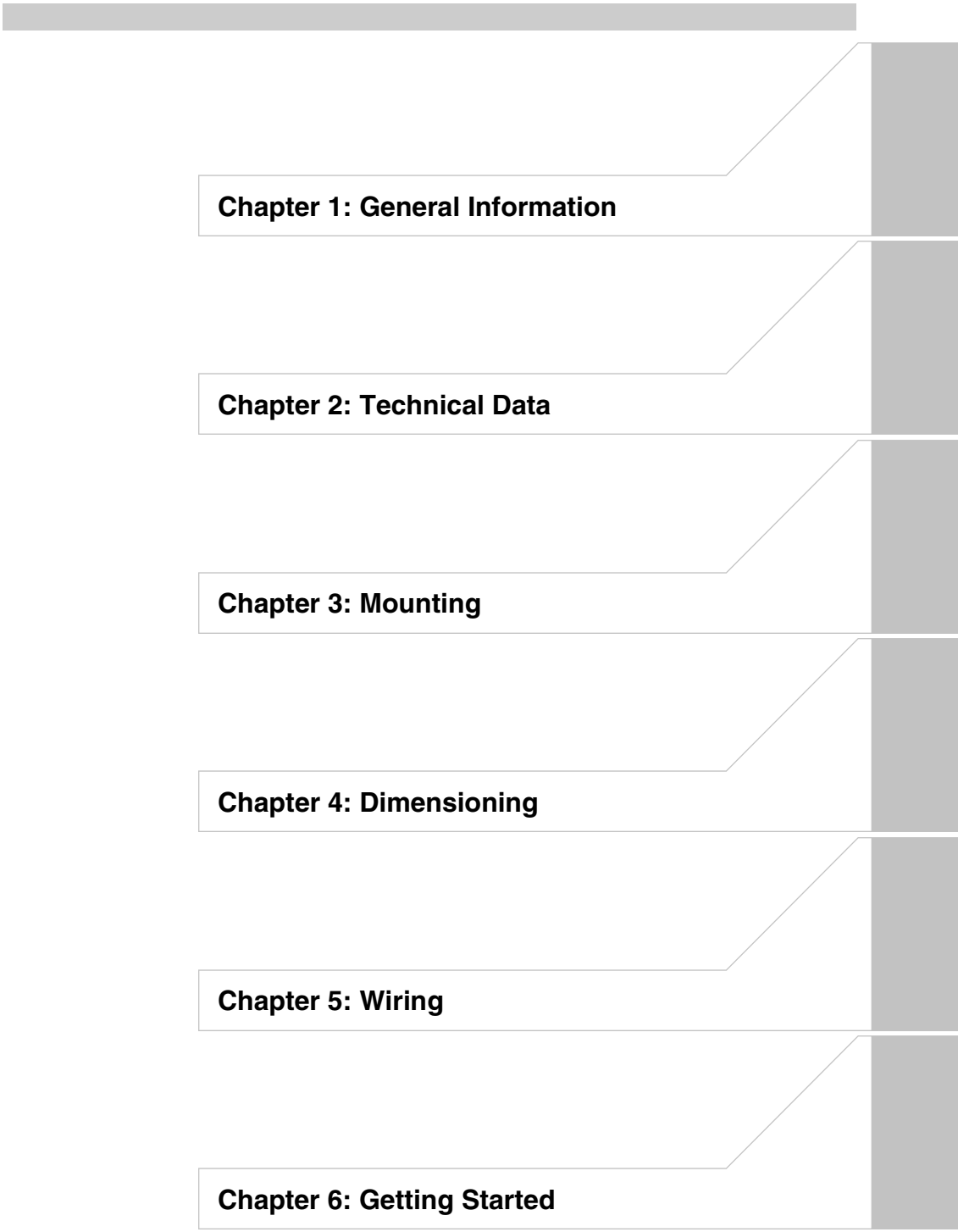


ACOPOS

User's Manual

Version: **1.2 (June 2003)**
Mod. No.: **MAACP2-E**

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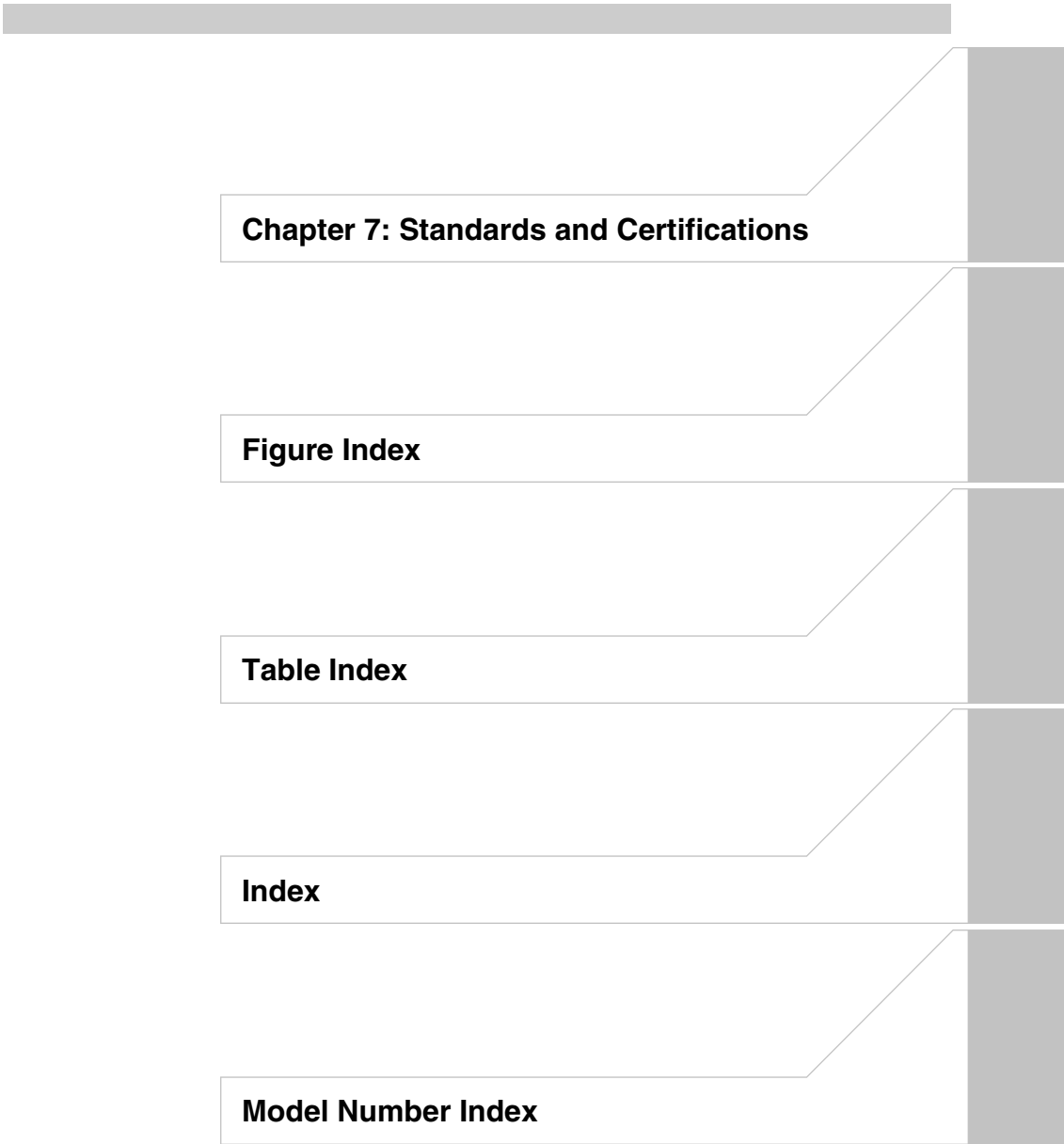
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Chapter 1 • General Information

1. ACOPOS

With the ACOPOS product line, B&R provides the basis for complete and uniform automation solutions. Branch specific functions and intuitive tools allow for short development times and create more room for innovation.

1.1 Secure Operation

EMC was given special attention in order to guarantee proper operation in an industrial environment. Field tests have been carried out under difficult conditions in addition to the tests defined in the standard. The results confirm the excellent values measured by the testing laboratory and during operation. The filters required to meet the CE guidelines are also integrated in the device. This simplifies installation considerably.



Figure 1: Secure operation

The embedded parameter chip on the motor is one factor used to guarantee maximum security. It contains all mechanical and electronic data relevant to the functionality of the motor. Parameters no longer have to be set manually and start-up times are substantially reduced. Secure operation also means that relevant data can be requested during service and the cause of the problem can be determined.

1.2 Taking it to the Limit

Operational security is also improved by monitoring high temperature components (IGBT modules, brake resistor, motor windings). Computer-based simulation allows component temperatures which cannot be measured directly to be calculated. One example is the junction temperature. This is a decisive value for the maximum load of a semiconductor. Using these models, a sufficiently precise value can be determined for each IGBT. Hot spots can be ruled out and the full dynamic properties of the device can be used at low rpm values and when stalled. The brake resistor and motor windings are monitored in the same way.

This form of monitoring allows better use of absolute limits on the drive and provides the user with the advantages of higher performance at lower costs.

1.3 Individual I/O Configurations

The I/O points needed to operate a servo axis are part of the standard equipment for ACOPOS drives. The user is provided two trigger inputs for tasks requiring precise measurements or print mark control. Sensor and actuator configurations are made using modular plug-in modules. This modular concept allows the optimum configuration to be selected to meet the requirements of the application.



Figure 2: Individual I/O configurations

1.4 Configuring instead of Programming

Long-term cooperation with our customers has provided us with fundamental knowledge in many positioning application areas. This knowledge can be passed on to our customers in the form of clear and easy to use function blocks. Industry specific functionality can be quickly and easily implemented in an application program.

1.5 Easy Service

All necessary data is placed in application memory on the controller so that service is limited to simply exchanging the device. The program does not have to be changed. After the system is started again, the controller installs the operating system that is used automatically (or when requested by the user). After this procedure is complete, the parameters are sent to the servo drive again. Problems resulting from different software versions or parameters can be ruled out.

1.6 Software and Hardware as a Unit

B&R integrates all relevant technologies in one tool - B&R Automation Studio™.

Adding a B&R ACOPOS servo drive is done in a Windows Look & Feel environment which becomes routine after using the program a few times. Wizards and selection boxes ease configuration of servo axis parameters. The target system is shown in a clear tree structure. Detailed information concerning the target system, with integrated hardware documentation ranging from software to terminal assignments, reduces project development times considerably.

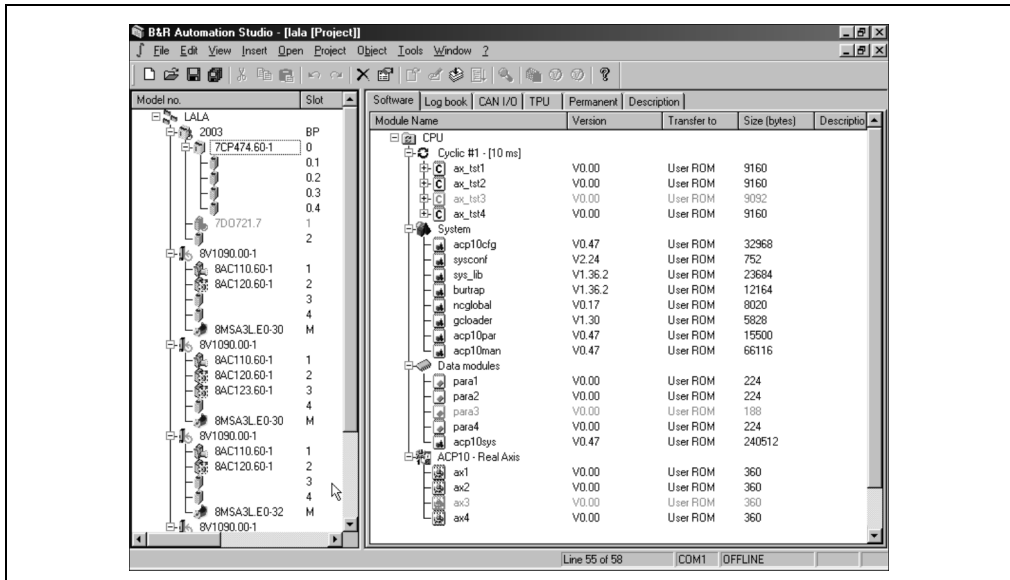


Figure 3: Software and hardware as a unit

1.7 Plain Text for Functions

NC Objects that can be accessed by the application program are also stored on the CPU (like the application program).

Creating NC Objects (for axes, a CNC system or a cam profile) takes place using dialog boxes and special data module editors. The individual hardware and software channels are assigned symbolic names. This eases use and increases clarity. The initial parameters are set in a separate editor in plain text.

1.8 Simple Function Test

The built-in NC test allows an axis to be used without a line of program code being written. As seen in the picture, several editors are grouped together as a single window. All movements, ranging from point-to-point movements to gear functions, can be carried out using an NC Action. The reaction of the axis can be seen online in the monitor window. If the trace function is turned on, relevant data - from position to motor temperature - is recorded on the drive. The multiple curve display in the trace window allows simple evaluation of the movement results.

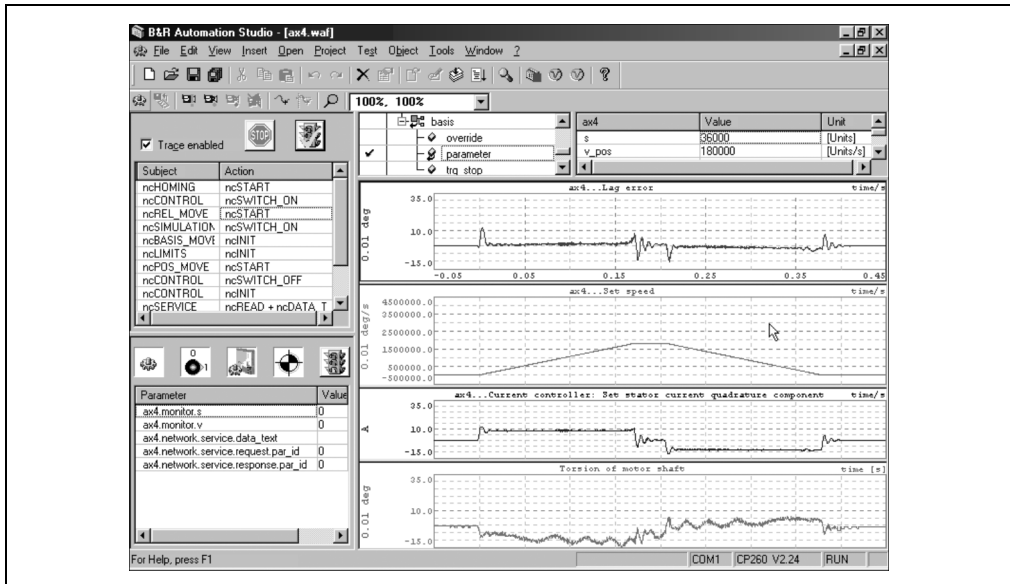


Figure 4: Simple function test

1.9 Control Trigger

The oscilloscope in the drive allows movements to be monitored in real time. Many trigger possibilities allow data required for analysis to be easily obtained. The graphic display of diagnosis data supports the user when making fine adjustments and when optimizing the movement. Measurement cursor and reference points allow μs precision.

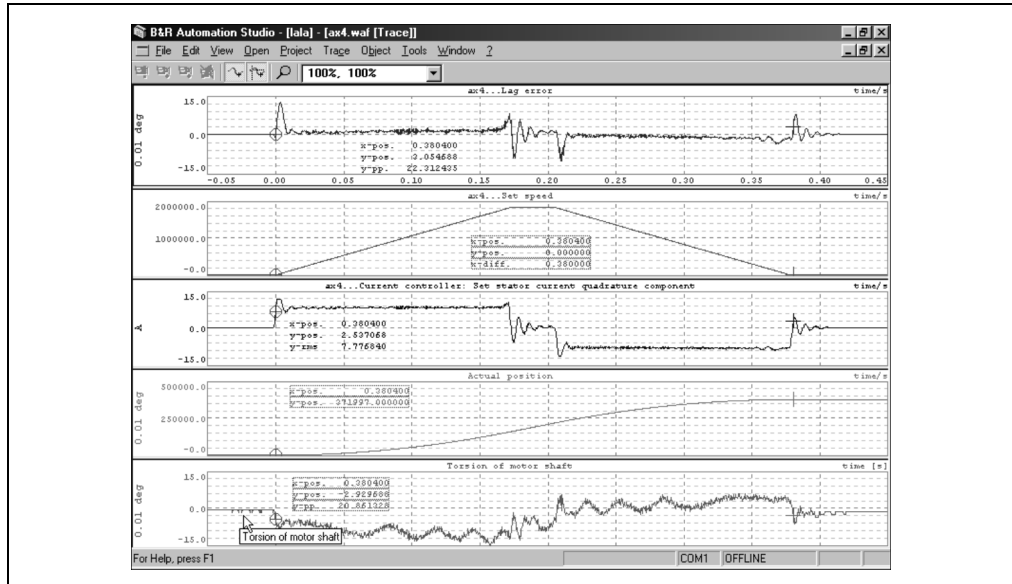


Figure 5: Control trigger

1.10 Cam Profiles for Everyone

Modular technology plug-ins allow homogenous integration of high performance tools such as the Cam Editor.

The mouse is used to define fixed points, synchronous sections or interpolations. Effects of positioning behavior on speed, acceleration and jolt for the slaves axes connected can be monitored directly.

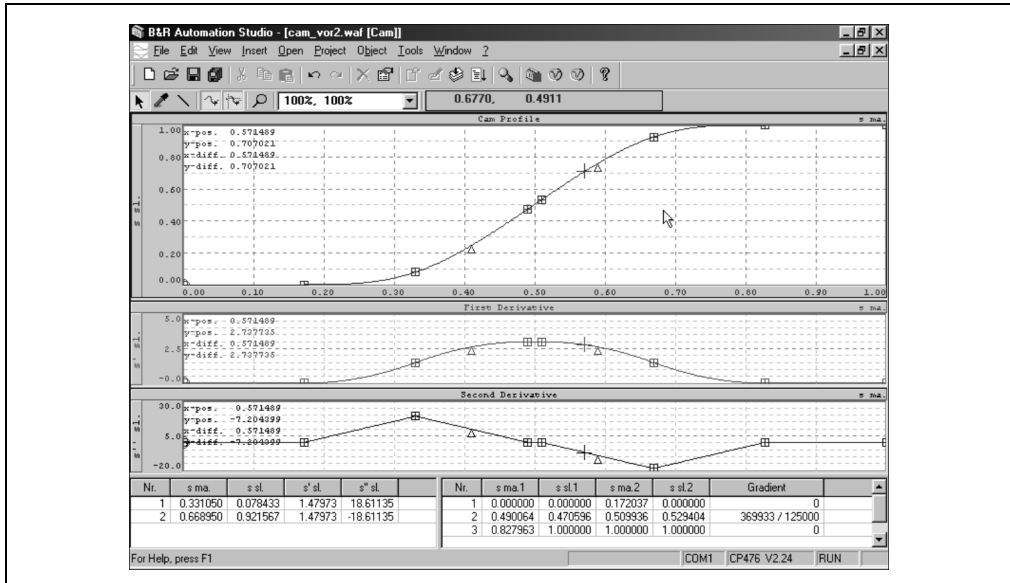


Figure 6: Cam profiles for everyone

2. ACOPOS Configurations

2.1 General Information

The ACOPOS servo drives can be used in various configurations depending on the network type (CAN, Powerlink) and the requirements of the application.

The following ACOPOS functions are possible with all ACOPOS configurations:

- Point-to-point
- Electronic gears
- Electronic compensation gears
- Cross cutter
- Electronic cam profiles
- Flying saw
- Line shaft
- CNC

2.2 CAN

2.2.1 Configuration 1

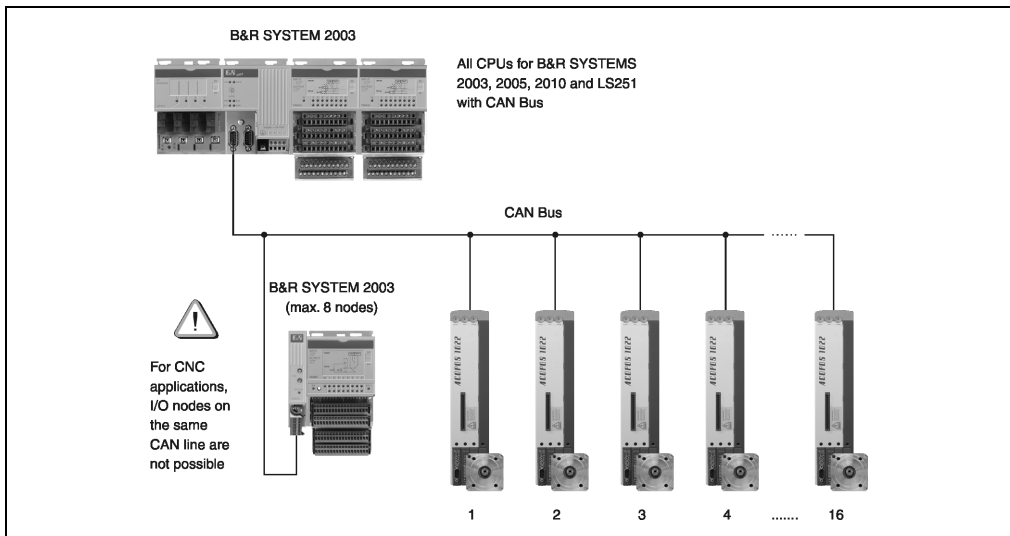


Figure 7: CAN configuration 1

2.2.2 Configuration 2

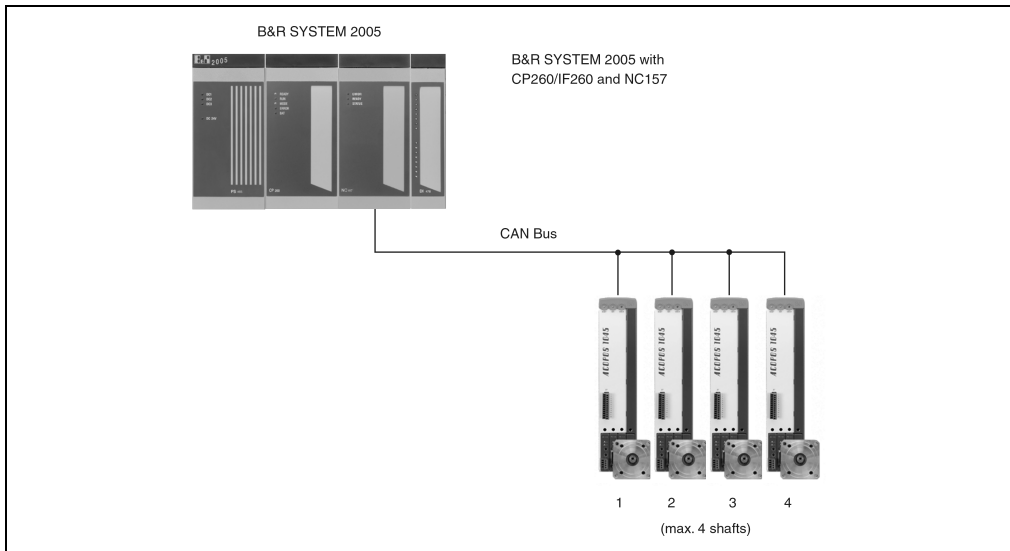


Figure 8: CAN configuration 2

2.3 Powerlink

2.3.1 Recommended Topology

In the Powerlink network (seen from the manager), the tree structure should always come first followed then by the line structure. Otherwise, the line structure delay affects the entire tree beneath it.

Information:

It should be noted that the longest path is allowed a maximum of 10 hubs by the manager.

Further Literature

Unless otherwise stated, these recommendations apply to the following documents:

- "Industrial Ethernet Planning and Installation Guide", Draft 2.0, IAONA (www.iaona-eu.com)
- "Guide to Understanding and Obtaining High Quality Generic Cabling", 3P Third Party Testing (www.3ptest.dk)

2.3.2 Configuration 1

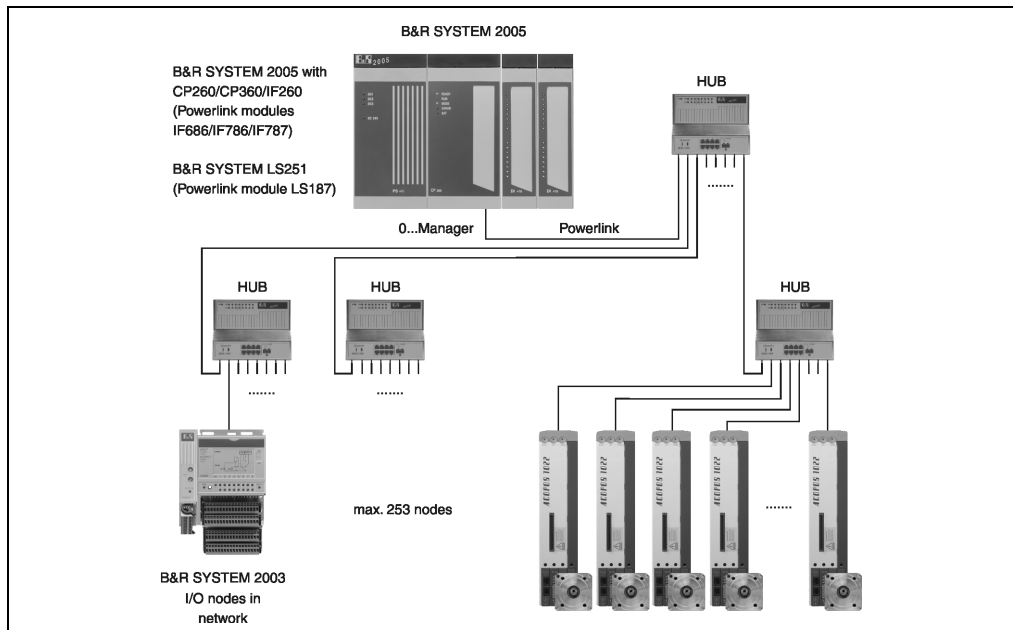


Figure 9: Powerlink configuration 1 - star topology

2.3.3 Configuration 2

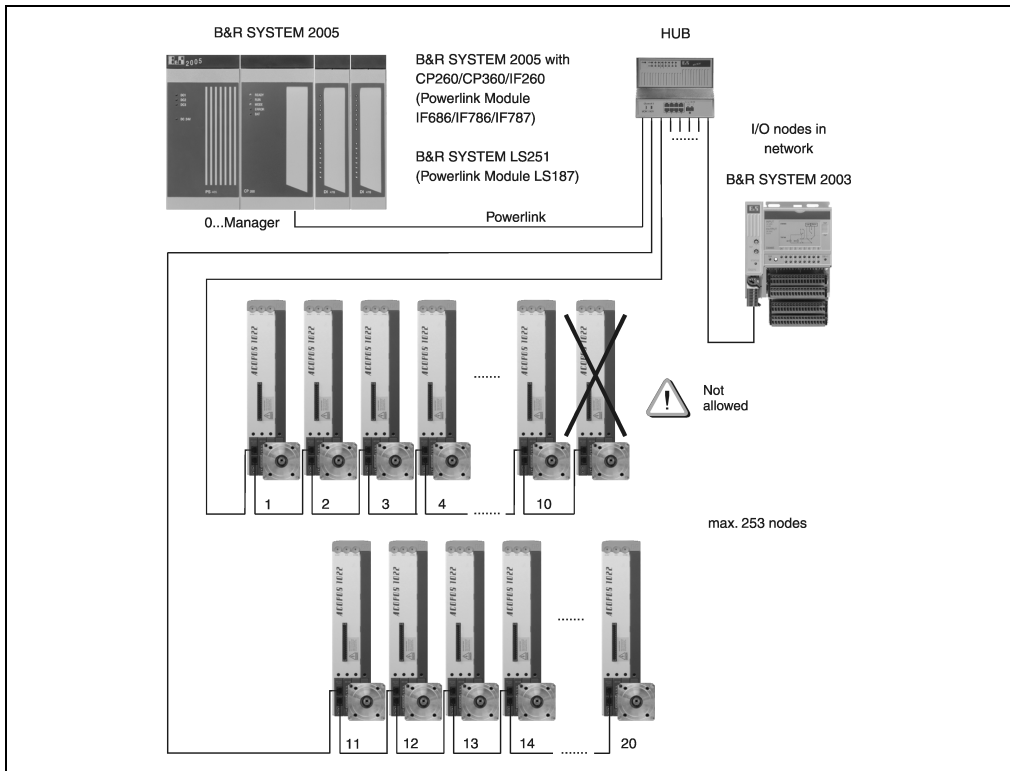


Figure 10: Powerlink configuration 2 - line topology

The advantage compared to configuration 1 is the low cabling expenditure for the same functionality.

3. Safety Guidelines

3.1 General Information

Danger!

Servo drives and servo motors can have bare parts with voltages applied (e.g. terminals) or hot surfaces. Additional sources of danger result from moving machine parts. Improperly removing the required covers, inappropriate use, incorrect installation or incorrect operation can result in severe personal injury or damage to property.

All tasks, such as transport, installation, commissioning and service, are only allowed to be carried out by qualified personnel. Qualified personnel are persons familiar with transport, mounting, installation, commissioning and operation of the product and have the respective qualifications (e.g. IEC 60364). National accident prevention guidelines must be followed.

The safety guidelines, connection descriptions (type plate and documentation) and limit values listed in the technical data are to be read carefully before installation and commissioning and must be observed.

Danger!

Handling servo drives incorrectly can cause severe personal injury or damage to property!

3.2 Intended Use

Servo drives are components designed to be installed in electrical systems or machines. They are not being used as intended unless the machine meets EG regulation 98/37/EG (machine regulation) as well as regulation 89/336/EEG (EMC regulation).

The servo drives are only allowed to be operated directly on grounded, three-phase industrial mains (TN, TT power mains). When using the servo drives in living areas, shops and small businesses, additional filtering measures must be implemented by the user.

The technical data as well as the values for connection and environmental guidelines can be found on the type plate and in the documentation. The connection and environmental guidelines must be met.

Electronic devices are generally not fail-safe. If the servo drive fails, the user is responsible for making sure that the motor is placed in a secure state.

3.3 Transport and Storage

During transport and storage, the devices must be protected from excessive stress (mechanical load, temperature, humidity, aggressive atmosphere).

Servo drives contain components sensitive to electrostatic charges which can be damaged by inappropriate handling. During installation/removal of servo drives, provide the necessary safety precautions against electrostatic discharges.

3.4 Installation

The installation must take place according to the documentation using suitable equipment and tools.

The devices are only allowed to be installed without voltage applied and by qualified personnel. Voltage to the switching cabinet should be switched off and prevented from being switched on again.

The general safety regulations and national accident prevention guidelines (e.g. VBG 4) must be observed when working with high voltage systems.

The electrical installation must be carried out according to the relevant guidelines (e.g. line cross section, fuse, protective ground connection, also see chapter 4 "Dimensioning").

3.5 Operation

3.5.1 Protection against Touching Electrical Parts

Danger!

To operate servo drives, it is necessary that certain parts are carrying voltages over 42 VDC. A life-threatening electrical shock could occur if you touch these parts. This could result in death, severe injury or material damage.

Before turning on the servo drive, make sure that the housing is properly connected to protective ground (PE rail). The ground connection must be made, even when testing the servo drive or when operating it for a short time!

Before turning the device on, make sure that all voltage carrying parts are securely covered. During operation, all covers and switching cabinet doors must remain closed.

Control and high power contacts can have voltage applied, even when the motor is not turning. Touching the contacts when the device is switched on is not permitted.

Before working on servo drives, they must be disconnected from the power mains and prevented from being switched on again.

Danger!

After switching off the device, wait until the DC bus discharge time of at least five minutes has passed. The voltage currently on the DC bus must be measured with a suitable measuring device before beginning work. This voltage must be less than 42 V DC to rule out danger. The Run LED going out does not indicate that voltage is not present on the device!

The connections for the signal voltages (5 to 30 V) found on the servo drives are isolated circuits. Therefore, the signal voltage connections and interfaces are only allowed to be connected to devices or electrical components with sufficient isolation according to IEC 60364-4-41 or EN 50178.

Never remove the electrical connections from the servo drive with voltage applied. In unfavorable conditions, arcs can occur causing personal injury and damage to contacts.

3.5.2 Protection from Dangerous Movements

Danger!

Incorrect control of motors can cause unwanted and dangerous movements! Such incorrect behavior can have various causes:

- **Incorrect installation or an error when handling the components**
- **Incorrect or incomplete wiring**
- **Defective devices (servo drive, motor, position encoder, cable, brake)**
- **Incorrect control (e.g. caused by software error)**

Some of these causes can be recognized and prevented by the servo drive using internal monitoring. However, it is generally possible for the motor shaft to move every time the device is switched on! Therefore protection of personnel and the machine can only be guaranteed using higher level safety precautions.

The movement area of machines must be protected to prevent accidental access. This type of protection can be obtained by using stabile mechanical protection such as protective covers, protective fences, protective gates or photocells.

Removing, bridging or bypassing these safety features and entering the movement area is prohibited.

A sufficient number of emergency stop switches are to be installed directly next to the machine. The emergency stop equipment must be checked before commissioning the machine.

Remove shaft keys on free running motors or prevent them from being catapulted.

The holding brake built into the motors cannot prevent hoists from allowing the load to sink.

3.6 Safety Guidelines

The safety guidelines are handled as follows:

Safety Guidelines	Description
Danger!	Disregarding the safety regulations and guidelines can be life-threatening.
Warning!	Disregarding the safety regulations and guidelines can result in severe injury or major damage to material.
Caution!	Disregarding the safety regulations and guidelines can result in injury or damage to material.
Information:	Important information for preventing errors

Table 1: Description of the safety guidelines

Chapter 2 • Technical Data

1. ACOPOS Servo Family

1.1 Modular Servo Drive Concept

Controlling your power transmission system with B&R ACOPOS servo drives allows you to fully use the advantages of an optimized system architecture. Applications that require additional positioning tasks such as torque limitation or torque control can be created quickly and elegantly.

The flexible system concept for B&R servo drives is achieved using matched hardware and software components. You can select the optimal system configuration for your application and increase your competitiveness.

- Perfect integration in the B&R 2000 product family
- Object-oriented axis programming minimizes development time and increases reusability
- Integrated technology functions for branch specific tasks
- Operation of synchronous and asynchronous motors possible
- Current controller scan time up to 50 μ s
- Reduced commissioning and service times using "embedded motor parameter chip"
- CAN and Powerlink network connection
- Input voltage range from 400 - 480 VAC (± 10 %) for use worldwide
- Connection possibilities for all standard encoder systems
- 2 free slots for optional technology modules
- Electronic secure restart inhibit integrated

1.2 General Description

The ACOPOS servo drive series covers a current range from 2.2 - 128 A and a power range from 1 - 64 kW with 7 devices in 3 groups. The devices in a group are designed using the same basic concept.

Group	8V1022.00-2 8V1045.00-2 8V1090.00-2	8V1180.00-2 8V1320.00-2	8V1640.00-2 8V128M.00-2
Power Connections	Plug connection	Plug connection	Fixed
Integrated Line Filter	Yes	Yes	... 1)
Mains Failure Monitoring	Yes	Yes	Yes
DC Bus Connection	Yes	Yes	Yes
24 VDC Supply	External 2)	External or internal via DC bus	External or internal via DC bus
24 VDC Output	No	24 V / 0.5 A	24 V / 0.5 A
Integrated Brake Chopper	Yes	Yes	Yes
Internal Braking Resistor	Yes	Yes	Yes 3)
Connection of External Braking Resistor Possible	No	Yes	Yes
Monitored Output for Motor Holding Brake	Yes	Yes	Yes
Monitored Input for Motor Temperature Sensor	Yes	Yes	Yes

Table 2: General description of the ACOPOS servo drive series

1) Integrated line filter in preparation.

2) External DC bus power supply OPS320.1 (24V / 20A) can be used.

3) The braking resistor integrated in the ACOPOS servo drives 1640 and 128M is dimensioned so that it is possible to brake to a stop (in a typical drive situation).

The ACOPOS servo drives also provide a modular fieldbus interface in addition to connection possibilities for all standard encoder systems.

ACOPOS servo drives are suitable for both synchronous and asynchronous servo motors and have built-in line filters to meet the limit values for CISPR11, Group 2, Class A.

Warning!

ACOPOS servo drives are suitable for power mains which can provide a maximum short circuit current of 10000 A_{eff} at a maximum of 528 V_{eff}.

1.2.1 24 VDC Supply during Power Failures

In order to be able to provide the stop function for category 1 according to IEC 60204-1 during a power failure, the 24 VDC supply voltage for the servo drives as well as encoders, sensors and the safety circuit must remain active during the entire stopping procedure.

The ACOPOS servo drives recognize a power failure and can immediately initiate active braking of the motor. The brake energy that occurs when braking is returned to the DC bus and the DC bus power supply can use it to create the 24 VDC supply voltage ¹⁾. An external DC bus power supply must be used for ACOPOS servo drives 8V1022 to 8V1090. A DC bus power supply is integrated in ACOPOS servo drives 8V1180 to 8V128M.

The ACOPOS servo drives with an integrated DC bus power supply provide the 24 VDC supply for the servo drive and also a 24 VDC output to supply encoders, sensors and the safety circuit. In many cases, it is not necessary to use an uninterruptible power supply (UPS) which is otherwise needed.

1.3 LEDs

The ACOPOS servo drives are equipped with three LEDs for direct diagnosis:

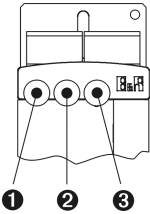
Image	LED	Description	Color
	1	Ready	Green
	2	Run	Orange
	3	Error	Red

Table 3: Status LEDs ACOPOS servo drives

If no LEDs are lit, the ACOPOS servo drive is not being supplied with 24 VDC.

Danger!

After switching off the device, wait until the DC bus discharge time of at least five minutes has passed. The voltage currently on the DC bus must be measured with a suitable measuring device before beginning work. This voltage must be less than 42 VDC to rule out danger. The Run LED going out does not indicate that voltage is not present on the device!

1) WARNING: In some applications, there is not enough brake energy provided to guarantee that the 24 VDC supply voltage remains active until the system is stopped.

Signal	LED	Description
Ready	Green	Lit when the ACOPOS servo drive is ready for operation and the power level can be enabled (operating system present and booted, no permanent or temporary errors).
Run	Orange	Lit as soon as the power level is enabled for the ACOPOS servo drive.
Error	Red	Lit when a permanent or temporary error exists on the ACOPOS servo drive. After correcting the error, the LED is automatically switched off. Examples of permanent errors: • Motor feedback not connected or defective • Low level on the enable input • Motor temperature sensor not connected or defective • Internal error on the device (e.g. IGBT heat sink temperature sensor defective) Examples of temporary errors: • 24 VDC supply voltage exceeds the tolerance range • DC bus voltage exceeds the tolerance range • Internal 15 VDC control voltage exceeds the tolerance range • IGBT current limit reached • Over-temperature on the motor (temperature sensor) • Over-temperature on the servo drive (IGBT junction, heat sink, conductive tracks) • Over-temperature on braking resistor • CAN or Powerlink network fault

Table 4: LED status

1.3.1 LED Status

The following timing is used for the indication diagrams:

Block size: 125 ms

Repeats after: 3000 ms

Status changes when booting the operating system loader

[illegible]

Table 5: Status changes when booting the operating system loader

Error status with reference to the CAN plug-in module AC110

Status	LED	Display																							
Boot error on CAN basic hardware	Green																								
	Orange																								
	Red	■		■		■		■								■		■		■		■			
Bus Off	Green																								
	Orange																								
	Red	■		■		■										■		■		■					
CAN node number is 0	Green																								
	Orange																								
	Red	■		■												■		■							

Table 6: Error status with reference to the CAN plug-in module AC110

Error status with reference to the ETHERNET Powerlink plug-in module AC112

Status	LED	Display																							
Boot error on Powerlink basic hardware	Green																								
	Orange																								
	Red	■		■		■		■								■		■		■		■			
Error when booting the AC112-ARM	Green																								
	Orange																								
	Red	■		■		■										■		■		■					
Powerlink node number is 0	Green																								
	Orange																								
	Red	■		■												■		■							

Table 7: Error status with reference to the ETHERNET Powerlink plug-in module AC112

1.4 ACOPOS 1022, 1045 and 1090

1.4.1 Order Data

Model Number	Short Description	
	Servo Drives	
8V1022.00-2	Servo drive 3 x 400-480V 2.2A 1kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1045.00-2	Servo drive 3 x 400-480V 4.4A 2kW, line filter, braking resistor and electronic secure restart inhibit integrated	
8V1090.00-2	Servo drive 3 x 400-480V 8.8A 4kW, line filter, braking resistor and electronic secure restart inhibit integrated	
	Accessories	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface	
8AC122.60-2	ACOPOS plug-in module, resolver interface	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10V, 2 digital I/O points which can be configured as 24V input or 45mA output	
0PS320.1	24 VDC power supply, 3-phase, 20 A, input 400..500 VAC (3 phases), wide range, DIN rail mounting	

Table 8: Order data for ACOPOS 1022, 1045 and 1090

1.4.2 Technical Data

Product ID	8V1022.00-2	8V1045.00-2	8V1090.00-2
General Information			
C-UL-US Listed	Yes		
Power mains connection			
Mains Input Voltage	3 x 400 VAC to 480 VAC ±10 % Power filter according to IEC 61800-3-A11 second environment (Limits from CISPR11, Group 2, Class A)		
Frequency	50 / 60 Hz ± 4 %		
Installed Load	Max. 3 kVA	Max. 5 kVA	Max. 10 kVA
Starting Current at 400 VAC	4 A	7 A	7 A
Switch-on Interval	> 10 s		
Power Loss at Max. Device Power without Brake Resistor	Approx. 120 W	Approx. 180 W	Approx. 200 W

Table 9: Technical data for ACOPOS 1022, 1045 and 1090

Product ID	8V1022.00-2	8V1045.00-2	8V1090.00-2
24 VDC Supply			
Input Voltage ¹⁾	24 VDC +25 % / -20 %		
Input Capacitance	8200 µF		
Current Requirements ²⁾	Max. 2.5 A + current for motor holding brake		
Motor Connection			
Maximum Switching Frequency	20 kHz	20 kHz	10 kHz
Continuous Current at 400 VAC	2.2 A _{eff}	4.4 A _{eff}	8.8 A _{eff}
Continuous Current at 480 VAC	1.7 A _{eff}	3.3 A _{eff}	6.6 A _{eff}
Peak Current	14 A _{eff}	24 A _{eff}	24 A _{eff}
Maximum Motor Line Length	25 m		
Protective Measures	Short circuit and ground fault protection		
Motor Holding Brake Connection			
Maximum Output Current	1 A		
Protective Measures	Short circuit and ground fault protection		
Braking resistor			
Peak Power Output	3.5 kW	7 kW	7 kW
Continuous Power Output	130 W	200 W	200 W
Operational Conditions			
Environment Temperature during Operation	0 to +40 °C		
Relative Humidity during Operation	5 to 95 %, non-condensing		
Reduction of the Continuous Current at Installation Altitudes over 500 m above Sea Level	10 % per 1000 m		
Maximum Installation Altitude	2000 m ³⁾		
Degree of Pollution according to IEC 60664-1	2 (non-conductive material)		
Over-voltage Category according to IEC 60364-4-443:1999	II		
Protection according to IEC 60529	IP20		
Storage and Transport Conditions			
Storage Temperature	-25 to +55 °C		
Relative Humidity during Storage	5 to 95 %, non-condensing		
Transport Temperature	-25 to +70 °C		
Relative Humidity during Transport	95 % at +40 °C		
Mechanical Characteristics			
Dimensions			
Width	70.5 mm		
Height	375 mm		
Depth	235.5 mm		
Weight	4.0 kg	4.1 kg	4.4 kg

Table 9: Technical data for ACOPOS 1022, 1045 and 1090 (cont.)

- 1) When using motor holding brakes, the valid input voltage range is reduced. The input voltage range should be selected so that the proper supply voltage for the brake can be maintained.
- 2) The current requirements depend on the configuration of the ACOPOS servo drive. To determine the current requirements, see section 5 "Configuration of ACOPOS Servo Drives", on page 117.
- 3) Additional requirements are to be arranged with B&R.

1.5 ACOPOS 1180, 1320

1.5.1 Order Data

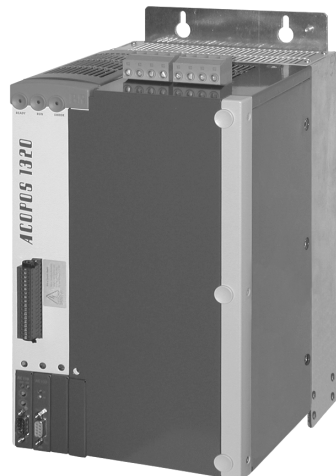
Model Number	Short Description	
	Servo Drives	
8V1180.00-2	Servo drive 3 x 400-480V 18A 9kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated	
8V1320.00-2	Servo drive 3 x 400-480V 32A 16kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated	
	Accessories	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface	
8AC122.60-2	ACOPOS plug-in module, resolver interface	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10V, 2 digital I/O points which can be configured as 24V input or 45mA output	
0PS320.1	24 VDC power supply, 3-phase, 20 A, input 400..500 VAC (3 phases), wide range, DIN rail mounting	

Table 10: Order data for ACOPOS 1180, 1320

1.5.2 Technical Data

Product ID	8V1180.00-2	8V1320.00-2
General Information		
C-UL-US Listed	Yes	
Power mains connection		
Mains Input Voltage	3 x 400 VAC to 480 VAC ±10 % Power filter according to IEC 61800-3-A11 second environment (Limits from CISPR11, Group 2, Class A)	
Frequency	50 / 60 Hz ± 4 %	
Installed Load	Max. 17 kVA	Max. 30 kVA
Starting Current at 400 VAC	13 A	
Switch-on Interval	> 10 s	
Power Loss at Max. Device Power without Brake Resistor	Approx. 500 W	Approx. 800 W

Table 11: Technical data for ACOPOS 1180, 1320

Product ID	8V1180.00-2	8V1320.00-2
24 VDC Supply		
Input Voltage	24 VDC +25 % / -20 %	
Input Capacitance	40000 µF	
Current Requirements ¹⁾ Mains Input Voltage Applied Mains Input Voltage not Applied	... 2) Max. 2.8 A + current for the motor holding brake + current on the 24 VDC output	
Motor Connection		
Maximum Switching Frequency	10 kHz	
Continuous Current at 400 VAC	19 A _{eff}	34 A _{eff}
Continuous Current at 480 VAC	14 A _{eff}	25 A _{eff}
Peak Current	50 A _{eff}	80 A _{eff}
Maximum Motor Line Length	25 m	
Protective Measures	Short circuit and ground fault protection	
Motor Holding Brake Connection		
Maximum Output Current	1.5 A	
Protective Measures	Short circuit and ground fault protection	
Braking resistor		
Peak Power Int. / Ext.	14 / 40 kW	
Continuous Power Int. / Ext.	0.4 / 8 kW	
Operational Conditions		
Environment Temp. during Operation	0 to +40 °C	
Relative Humidity during Operation	5 to 95 %, non-condensing	
Reduction of the Continuous Current at Installation Altitudes over 500 m above Sea Level	10 % per 1000 m	
Maximum Installation Altitude	2000 m ³⁾	
Degree of Pollution acc. to IEC 60664-1	2 (non-conductive material)	
Over-voltage Category according to IEC 60364-4-443:1999	II	
Protection according to IEC 60529	IP20	
Storage and Transport Conditions		
Storage Temperature	-25 to +55 °C	
Relative Humidity during Storage	5 to 95 %, non-condensing	
Transport Temperature	-25 to +70 °C	
Relative Humidity during Transport	95 % at +40 °C	
Mechanical Characteristics		
Dimensions Width Height Depth	200 mm 375 mm 234 mm	
Weight	10.7 kg	11.3 kg

Table 11: Technical data for ACOPOS 1180, 1320 (cont.)

- 1) The current requirements depend on the configuration of the ACOPOS servo drive. To determine the current requirements, see section 5 "Configuration of ACOPOS Servo Drives", on page 117.
- 2) The 24 VDC supply voltage for the ACOPOS servo drive is created by the integrated DC bus power supply, which reduces the 24 VDC current requirements (I_{24VDC}) to 0. Mains Input Voltage: 3 x 400 VAC to 480 VAC $\pm$ 10 %.
- 3) Additional requirements are to be arranged with B&R.

1.6 ACOPOS 1640, 128M

1.6.1 Order Data

Model Number	Short Description	Image 
	Servo Drives	
8V1640.00-2	Servo drive 3 x 400-480V 64A 32kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated ¹⁾	
8V128M.00-2	Servo drive 3 x 400-480V 128A 64kW, line filter, braking resistor, DC bus power supply and electronic secure restart inhibit integrated ¹⁾	
	Accessories	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface	
8AC122.60-2	ACOPOS plug-in module, resolver interface	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ±10V, 2 digital I/O points which can be configured as 24V input or 45mA output	
0PS320.1	24 VDC power supply, 3-phase, 20 A, input 400..500 VAC (3 phases), wide range, DIN rail mounting	

Table 12: Order data for ACOPOS 1640, 128M

1) Integrated line filter in preparation.

1.6.2 Technical Data

Product ID	8V1640.00-2	8V128M.00-2
General Information		
C-UL-US Listed	Yes	
Power mains connection		
Mains Input Voltage	3 x 400 VAC to 480 VAC ±10 % Power filter according to IEC 61800-3-A11 second environment (Limits from CISPR11, Group 2, Class A) ¹⁾	
Frequency	50 / 60 Hz ± 4 %	
Installed Load	Max. 54 kVA	Max. 98 kVA
Starting Current at 400 VAC	26 A	
Switch-on Interval	> 10 s	
Power Loss at Max. Device Power without Brake Resistor	Approx. 1600 W	Approx. 3200 W

Table 13: Technical data for ACOPOS 1640, 128M

Product ID	8V1640.00-2	8V128M.00-2
24 VDC Supply		
Input Voltage	24 VDC +25 % / -20 %	
Input Capacitance	32800 µF	
Current requirements at 24 VDC ²⁾ Mains Input Voltage Applied Mains Input Voltage not Applied	--- ³⁾ Max. 6 A + 1.4 * (current for the motor holding brake + current on the 24 VDC output)	
Motor Connection		
Maximum Switching Frequency	10 kHz	5 kHz
Continuous Current at 400 VAC	64 A _{eff}	128 A _{eff}
Continuous Current at 480 VAC	48 A _{eff}	96 A _{eff}
Peak Current	200 A _{eff}	300 A _{eff}
Maximum Motor Line Length	25 m	
Protective Measures	Short circuit and ground fault protection	
Motor Holding Brake Connection		
Maximum Output Current	3 A	
Protective Measures	Short circuit and ground fault protection	
Braking resistor		
Peak Power Int. / Ext.	7 / 250 kW	8.5 / 250 kW
Continuous Power Int. / Ext.	0.2 / 24 kW	0.24 / 24 kW
Operational Conditions		
Environment Temp. during Operation	0 to +40 °C	
Relative Humidity during Operation	5 to 95 %, non-condensing	
Reduction of the Continuous Current at Installation Altitudes over 500 m above Sea Level	10 % per 1000 m	
Maximum Installation Altitude	2000 m ⁴⁾	
Degree of Pollution acc. to IEC 60664-1	2 (non-conductive material)	
Over-voltage Category according to IEC 60364-4-443:1999	II	
Protection according to IEC 60529	IP20	
Storage and Transport Conditions		
Storage Temperature	-25 to +55 °C	
Relative Humidity during Storage	5 to 95 %, non-condensing	
Transport Temperature	-25 to +70 °C	
Relative Humidity during Transport	95 % at +40 °C	
Mechanical Characteristics		
Dimensions		
Width	276 mm	402 mm
Height	460 mm	460 mm
Depth	295 mm	295 mm
Weight	24.1 kg	33.8 kg

Table 13: Technical data for ACOPOS 1640, 128M (cont.)

- 1) Integrated line filter in preparation.
- 2) The current requirements depend on the configuration of the ACOPOS servo drive. To determine the current requirements, see section 5 "Configuration of ACOPOS Servo Drives", on page 117.
- 3) The 24 VDC supply voltage for the ACOPOS servo drive is created by the integrated DC bus power supply, which reduces the 24 VDC current requirements (I_{24VDC}) to 0. Mains Input Voltage: 3 x 400 VAC to 480 VAC ± 10 %.
- 4) Additional requirements are to be arranged with B&R.

2. ACOPOS Plug-in Modules

2.1 General Information

The ACOPOS drives are equipped with four plug-in module slots. You can select the plug-in modules required for your application and insert them into the ACOPOS servo drive.

2.2 Order Data

Model Number	Short Description
8AC110.60-2	ACOPOS plug-in module, CAN interface
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface
8AC122.60-2	ACOPOS plug-in module, resolver interface
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs $\pm 10V$, 2 digital I/O points which can be configured as 24V input or 45mA output

Table 14: Order data for plug-in modules

2.3 AC110 - CAN Interface

2.3.1 General Description

The AC110 plug-in module can be used in an ACOPOS slot. The module is equipped with a CAN interface. This fieldbus interface is used for communication and setting parameters on the ACOPOS servo drive for standard applications.

2.3.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC110.60-2	ACOPOS plug-in module, CAN interface	
	Accessories	
7AC911.9	Bus connector, CAN	
0AC912.9	Bus adapter, CAN, 1 CAN interface	
0AC913.92	Bus adapter, CAN, 2 CAN interfaces, including 30 cm connection cable	

Table 15: Order data for AC110

2.3.3 Technical Data

Product ID	8AC110.60-2
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot	Slot 1
Power Consumption	Max. 0.7 W
CAN Interface	
Connection, Module Side	9 pin DSUB plug
LEDs	RXD/TXD LEDs
Electrical isolation CAN - ACOPOS	Yes

Table 16: Technical Data for AC110

Product ID	8AC110.60-2
Maximum Distance	60 m
Baud Rate	500 kBit/s
Network Capable	Yes
Bus Termination Resistor	Externally wired
Operational Conditions	
Environment Temperature during Operation	0 to +50 °C
Relative Humidity during Operation	5 to 95 % (non condensing)
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity during Storage	5 to 95 %, non-condensing
Transport Temperature	-25 to +70 °C
Relative Humidity during Transport	95 % at +40 °C

Table 16: Technical Data for AC110 (cont.)

2.3.4 CAN Node Number Settings

The CAN node number can be set using two HEX code switches: ¹⁾

Code Switch	CAN Node Number
Top	16s position (high)
Bottom	1s position (low)

Table 17: Setting the CAN node number with the two HEX code switches

Changing the node number becomes active the next time the ACOPOS servo drive is switched on.

There must be a terminating resistor (120 Ω , 0.25 W) between CAN_H and CAN_L at the beginning and end of the CAN bus.

2.3.5 LEDs

The status LEDs show if data is being received (RXD) or sent (TXD).

2.3.6 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

¹⁾ Changing the node number using software is not possible (Basis CAN ID can be changed).
 The ACOPOS Manager only supports node numbers from 1 - 32.
 When using the NC157 positioning module, only node numbers from 1 - 8 are possible.

2.4 AC112 - ETHERNET Powerlink Interface

2.4.1 General Description

The AC112 plug-in module can be used in an ACOPOS slot. The module is equipped with an ETHERNET Powerlink interface. This fieldbus interface is used for communication and setting parameters on the ACOPOS servo drive for complex and time critical applications.

The plug-in module is set up as a 2x hub. This makes it easy to establish a device to device connection (line topology).

2.4.2 Order Data

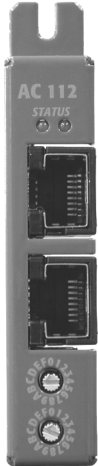
Model Number	Short Description	Image
	Plug-in Module	
8AC112.60-1	ACOPOS plug-in module, ETHERNET Powerlink interface	

Table 18: Order data for AC112

2.4.3 Technical Data

Product ID	8AC112.60-1
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot	Slot 1
Power Consumption	Max. 2.5 W

Table 19: Technical data for AC112

Product ID	8AC112.60-1
Powerlink Interface	
Connection, Module Side	2 x RJ45 socket
LEDs	Status LEDs
Electrical isolation ETHERNET - ACOPOS	Yes
Maximum Distance per Segment	100 m ¹⁾
Baud Rate	100 Mbit/s
Network Capable	Yes
Hub, 2x	Yes
Maximum Number of Hub Levels	10; see section 2 "ACOPOS Configurations", on page 22
Cabling Topology	Star or tree with level 2 hubs
Possible Station Operating Modes	Synchronous to Powerlink cycle
Watchdog Function Hardware Software	Yes (via ACOPOS servo drive) Yes (via ACOPOS servo drive)
Operational Conditions	
Environment Temperature during Operation	0 to +50 °C
Relative Humidity during Operation	5 to 95 %, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity during Storage	5 to 95 %, non-condensing
Transport Temperature	-25 to +70 °C
Relative Humidity during Transport	95 % at +40 °C

Table 19: Technical data for AC112 (cont.)

1) With a cycle time of 400 µs and 10 ACOPOS servo drives, the maximum total cable length is 200 m.

2.4.4 Powerlink Node Number Setting

The Powerlink node number can be set using two HEX code switches:

Code Switch	Powerlink Node Number
Top	16s position (high)
Bottom	1s position (low)

Table 20: Setting the Powerlink node number with the two HEX code switches

Changing the node number becomes active the next time the ACOPOS servo drive is switched on.

2.4.5 LEDs

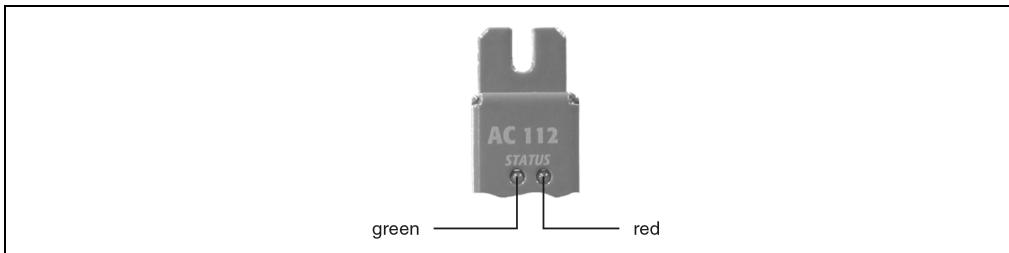


Figure 11: Status LEDs AC112

The status is indicated on the AC112 using one green and one red LED.

LED Test

Immediately after resetting the module, both LEDs are switched off for 0.5 s, then switched on for 1.5 s.

Then the green LED is cleared for one second and the following boot procedure. After proper initialization, the red LED is switched off and the green LED is switched on.

Status of the LEDs

The following timing is used for the indication diagram:

Block size: 150 ms

Status	LED	Display
Error-free operation	Green	[Solid Green Bar]
	Red	[Solid Black Bar]
Fatal system error ¹⁾	Green	[Solid Black Bar]
	Red	[Solid Red Bar]
Master has dropped out	Green	[Alternating Green and Black Bars]
	Red	[Alternating Red and Black Bars]
System stop ²⁾	Green	[Solid Black Bar]
	Red	See System Stop Error Codes

Table 21: Indication diagram for the AC112 status LEDs

1) This is a problem which cannot be repaired, the system can no longer carry out tasks correctly.
This status can only be changed by resetting the module.

2) The red LED blinks an error code, the output of the error code occurs in 4 short (150 ms) or long (600 ms) phases.

System stop error codes

The following timing is used for the indication diagram:

Block size: 150 ms

Pause: 2000 ms

Error	Display																																	
Stack overflow																																		
RAM error																																		
Undefined address ¹⁾																																		
Instruction fetch memory abort ²⁾																																		
Data access memory abort ³⁾																																		
Assertion failed ⁴⁾																																		
Programming failed ⁵⁾																																		

Table 22: System stop error codes

- 1) Access of non-existent address.
- 2) Invalid memory access during instruction fetch (e. g. WORD access of add numbered address).
- 3) Invalid memory access during data access (e. g. WORD access of add numbered address).
- 4) This system stop code only occurs in debug mode. The condition for a software assertion was not fulfilled.
- 5) Error during programming.

2.4.6 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.5 AC120 - EnDat Encoder Interface

2.5.1 General Description

The AC120 plug-in module can be used in an ACOPOS slot. The module has an EnDat encoder interface, but can also be used to evaluate simple incremental encoders with sine formed output signal ¹⁾.

This module can be used to evaluate encoders which are built into B&R servo motors and also encoders for external axes (encoders that evaluate any machine movement). The input signals are monitored. In this way, broken connections, shorted lines and encoder supply failure can be recognized.

EnDat Encoder:

EnDat is a standard developed by Johannes Heidenhain GmbH (www.heidenhain.de), incorporating the advantages of absolute and incremental position measurement and also offers a read/write parameter memory in the encoder. With absolute position measurement (absolute position is read in serially), the homing procedure is usually not required. When necessary, a multi-turn encoder (4096 revolutions) should be installed. To save costs, a single-turn encoder and a reference switch can also be used. In this case, a homing procedure must be carried out.

The incremental process allows the short delay times necessary for position measurement on drives with exceptional dynamic properties. With the sinusoidal incremental signal and the fine resolution in the EnDat module, a very high positioning resolution is achieved in spite of the moderate signal frequencies used.

The parameter memory in the EnDat encoder is used by B&R to store motor data (among other things). In this way, the ACOPOS servo drives are always automatically provided the correct motor parameters and limit values. This is referred to as the "embedded parameter chip".

During start-up, the module is automatically identified, configured and its parameters set by the ACOPOS servo drive operating system.

Incremental encoder with sine formed output signal:

When using the AC120 plug-in module to evaluate simple incremental encoders with sine formed output signal, only the incremental transfer channel is now used. The "embedded parameter chip" is not available in this case because this encoder does not have parameter memory. The absolute position is also not available immediately after switching the device on. In this situation, a homing procedure normally has to be carried out. The module is equipped with a reference pulse input for this purpose.

1) Starting with revision F0.

2.5.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface	
	Accessories	
8CE005.12-1	EnDat cable, length 5m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17 pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE007.12-1	EnDat cable, length 7m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17 pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE010.12-1	EnDat cable, length 10m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17 pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE015.12-1	EnDat cable, length 15m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17 pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE020.12-1	EnDat cable, length 20m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17 pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE025.12-1	EnDat cable, length 25m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17 pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	

Table 23: Order data for AC120

2.5.3 Technical Data

Product ID	8AC120.60-1
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot ¹⁾	Slots 2, 3 and 4
Power Consumption	
E0 ... EnDat single-turn, 512 lines	Max. 1.8 W
E1 ... EnDat multi-turn, 512 lines	Max. 2.5 W
E2 ... EnDat single-turn, 32 lines (inductive)	Max. 2.2 W
E3 ... EnDat multi-turn, 32 lines (inductive)	Max. 1.9 W
E4 ... EnDat single-turn, 512 lines	Max. 1.7 W
E5 ... EnDat multi-turn, 512 lines	Max. 2.2 W
Encoder Input ²⁾	
Connection, Module Side	15 pin DSUB socket
LEDs	UP/DN LEDs
Electrical isolation Encoder - ACOPOS	No
Encoder Monitoring	Yes

Table 24: Technical data for AC120

Product ID	8AC120.60-1
Encoder Supply	
Output Voltage	Typ. 5 V
Load	200 mA
Sense Lines	2, compensation of max. 2 x 0.7 V
Sine Cosine Inputs	
Signal Transfer	Differential signal, symmetric
Differential Voltage	0.5 ... 1.25 V _{SS}
Common Mode Voltage	Max. ±7 V
Terminating Resistance	120 Ω
Signal Frequency	DC ... 400 kHz
Resolution ³⁾	16384 * number of encoder lines
Precision ⁴⁾	---
Reference Input	
Signal Transfer	Differential signal, symmetric
Differential Voltage for High	≥ +0.2 V
Differential Voltage for Low	≤ -0.2 V
Common-mode Voltage	Max. ±7 V
Terminating Resistance	120 Ω
Serial Interface	Synchronous
Signal Transfer	RS485
Baud Rate	625 kBaud
Operational Conditions	
Environment Temperature during Operation	0 to +50 °C
Relative Humidity during Operation	5 to 95 %, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity during Storage	5 to 95 %, non-condensing
Transport Temperature	-25 to +70 °C
Relative Humidity during Transport	95 % at +40 °C

Table 24: Technical data for AC120 (cont.)

- 1) The AC120 is an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
- 2) The EnDat encoder must be wired using a cable with a single shield.
- 3) Noise on the encoder signal reduces the resolution that can be used by approx. 4 bits (factor of 16).
- 4) The precision is actually limited by the encoder.

2.5.4 LEDs

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... lit when the encoder position changes in the positive direction.

DN LED ... lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

2.5.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.6 AC122 - Resolver Interface

2.6.1 General Description

The AC122 plug-in module can be used in an ACOPOS slot. The module is equipped with a resolver interface.

The plug-in module handles the output from resolvers which are built into B&R servo motors or used as an encoder for external axes. This resolver delivers the absolute position over one revolution. Normally, the movement path is longer than one revolution. In this case, a reference switch must be used and a homing procedure carried out.

The encoder input signals are monitored. In this way, broken connections, shorted lines and encoder supply failure (reference signal) can be recognized.

During start-up, the AC122 module is automatically identified by the ACOPOS operating system. Making automatic adjustments to the motor (resolution parameter) and reading the motor parameters and limit values is not possible because the resolver does not have parameter memory like the EnDat encoder.

If the precision, resolution, bandwidth or ease of setting parameters is not sufficient with the resolver, the EnDat system should be used (see section 2.5 "AC120 - EnDat Encoder Interface", on page 49).

2.6.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC122.60-2	ACOPOS plug-in module, resolver interface	
	Accessories	
8CR005.12-1	Resolver cable, length 5m, 3 x 2 x 24 AWG/19, resolver connector 12 pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR007.12-1	Resolver cable, length 7m, 3 x 2 x 24 AWG/19, resolver connector 12 pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR010.12-1	Resolver cable, length 10m, 3 x 2 x 24 AWG/19, resolver connector 12 pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR015.12-1	Resolver cable, length 15m, 3 x 2 x 24 AWG/19, resolver connector 12 pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR020.12-1	Resolver cable, length 20m, 3 x 2 x 24 AWG/19, resolver connector 12 pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR025.12-1	Resolver cable, length 25m, 3 x 2 x 24 AWG/19, resolver connector 12 pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	

Table 25: Order data for AC122

2.6.3 Technical Data

Product ID	8AC122.60-2
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot ¹⁾	Slots 2, 3 and 4
Power Consumption	Max. 1.2 W
Resolver Input ²⁾	
Resolver Type	BRX ³⁾
Number of Poles	2 pin
Nominal Voltage Ratio	0.5 ± 5 %
Input Frequency	10 kHz
Input Voltage	3 to 7 V _{rms}
Max. Phase Shift	± 3°
Max. El. Angular Error	± 10 angular minutes
Connection, Module Side	9 pin DSUB socket
LEDs	UP/DN LEDs
Electrical Isolation Resolver - ACOPOS	No
Encoder Monitoring	Yes
Resolution	Depends on the maximum speed 14 bits/rev for n < 3900 min ⁻¹ 12 bits/rev for n < 15600 min ⁻¹
Bandwidth	1.7 kHz for n < 3900 min ⁻¹ 2.5 kHz for n < 15600 min ⁻¹
Precision	± 8 angular minutes
Reference Output Signal Transfer Differential Voltage Output Current Frequency	Differential signals Typically 3.4 V _{eff} Max. 50 mA _{eff} 10 kHz
Sine-Cosine Inputs Signal Transfer Input Impedance at 10 kHz (per pin) Electrical Isolation Encoder-ACOPOS	Differential signals 10.4 kΩ - j 11.1 kΩ No, common-mode voltage on the sine cosine inputs max ± 20 V
Operational Conditions	
Environment Temperature during Operation	0 to +50 °C
Relative Humidity during Operation	5 to 95 %, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity during Storage	5 to 95 %, non-condensing
Transport Temperature	-25 to +70 °C
Relative Humidity during Transport	95 % at +40 °C

Table 26: Technical data for AC122

- 1) The AC122 is an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
- 2) The resolver must be wired using a cable with a single shield and twisted pair signal lines.
- 3) BRX resolvers are fed with a sine signal (reference signal) from the module and provide two sine signals with a 90° phase shift as a result. The amplitudes of these signals change with the angular position of the resolver.
Unlike BRX resolvers, BRT resolvers can be fed with two sine signals which are offset by 90°. A single sine signal with constant amplitude is returned. The phase position of this signal changes with the angular position of the resolver.

2.6.4 LEDs

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... lit when the encoder position changes in the positive direction.

DN LED ... lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

2.6.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.7 AC123 - Incremental Encoder and SSI Absolute Encoder Interface

2.7.1 General Description

The ACOPOS plug-in module AC123 is used to connect standard industrial incremental or absolute encoders with a synchronous serial interface (SSI) to ACOPOS servo drives. For example, this allows electronic gears to be configured which read master movements using external encoders. If the encoder resolution is high enough, motor feedback for asynchronous motors is also possible.

With incremental encoders, the maximum counter frequency is 200 kHz. Single and multi-turn encoders with a maximum of 31 bits at 200 kBaud can be read as absolute SSI encoders.

The position is determined cyclically (initiated by the module) and is exactly synchronized with the ACOPOS controller clock. The input signals are monitored for both encoder types. In this way, broken connections, shorted lines and encoder supply failure can be recognized.

With incremental encoders the count frequency and distance between edges is also monitored. With absolute encoders, the parity bit is evaluated and a plausibility check carried out.

2.7.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC123.60-1	ACOPOS plug-in module, incremental encoder and SSI absolute encoder interface	

Table 27: Order data for AC123

2.7.3 Technical Data

Product ID	8AC123.60-1
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot ¹⁾	Slots 2, 3 and 4
Power Consumption	Max. 7.5 W Depends on the current requirements for the encoder connected ²⁾
Encoder Input ³⁾	
Connection, Module Side	15 pin DSUB socket
LEDs	UP/DN LEDs
Electrical Isolation Encoder - ACOPOS	Yes
Encoder Monitoring	Yes
Signal Transfer	Differential signal transfer
Cable Length ⁴⁾	Max. 50 m
Encoder Supply	
Supply Voltages	Internal, select between 5 V/15 V
Sense Lines for 5 V for 15 V	Yes, 2, compensation of max. 2 V No
Load 5 V 15 V	350 mA 350 mA
Short Circuit Protection, Overload Protection	Yes
Incremental encoder ⁵⁾	
Signal Form	Square wave pulse
Evaluation	4-fold
Input Frequency	Max. 200 kHz
Count Frequency	Max. 800 kHz
Reference Frequency	Max. 200 kHz
Distance between Edges	Min. 0.6 µs
Counter Size	32-bit
Inputs	A, A\, B, B\, R, R\
Differential Voltage Inputs A, B, R Minimum Maximum	2.5 V 6 V
SSI Absolute Encoder	
Baud Rate	200 kBaud
Word Size	Max. 31 bit
Differential Voltage Clock Output - 120 Ω Minimum Maximum	2.5 V 5 V
Differential Voltage Data Input Minimum Maximum	2.5 V 6 V

Table 28: Technical data for AC123

Product ID	8AC123.60-1
Operational Conditions	
Environment Temperature during Operation	0 to +50 °C
Relative Humidity during Operation	5 to 95 %, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity during Storage	5 to 95 %, non-condensing
Transport Temperature	-25 to +70 °C
Relative Humidity during Transport	95 % at +40 °C

Table 28: Technical data for AC123 (cont.)

- 1) The AC123 is an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
- 2) The power consumption of the plug-in module can be approximated using the following formula:

$$P_{\text{Module}} [\text{W}] = P_{\text{Encoder}} [\text{W}] \cdot k + 0.6 \text{ W}$$

The power consumed by the encoder P_{Encoder} is calculated from the selected encoder supply voltage (5 V / 15 V) and the current required:

$$P_{\text{Encoder}} [\text{W}] = U_{\text{Encoder}} [\text{V}] \cdot I_{\text{Encoder}} [\text{A}]$$

The following values must be used for k:

$$k = 1.2 \text{ (with 15 V encoder supply)}$$

$$k = 1.75 \text{ (with 5 V encoder supply)}$$

- 3) The encoder must be wired using a cable with a single shield and twisted pair signal lines (e.g. $4 \times 2 \times 0.14 \text{ mm}^2 + 2 \times 0.5 \text{ mm}^2$).
- 4) A cable with at least $4 \times 2 \times 0.14 \text{ mm}^2 + 2 \times 0.5 \text{ mm}^2$ is required for the maximum cable length. The sense lines must be used.
- 5) Incremental encoders can be used as motor feedback only for asynchronous motors, but can only provide limited control quality for this purpose. An encoder with at least 1000 lines must be used for motor feedback.

2.7.4 LEDs

The UP/DN LEDs are lit depending on the rotational direction and the speed of the connected encoder.

UP LED ... lit when the encoder position changes in the positive direction.

DN LED ... lit when the encoder position changes in the negative direction.

The faster the encoder position changes, the brighter the respective LED is lit.

2.7.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.8 AC130 - Digital Mixed Module

2.8.1 General Description

The AC130 plug-in module can be used in an ACOPOS slot. A maximum of 8 digital inputs or 10 digital outputs are available.

I/O points can be configured in pairs as inputs or outputs. The first three inputs have incremental encoder functionality (A, B, R). The first two outputs can be operated in pulse width modulation (PWM) mode.

The inputs are divided into 4 standard (max. 10 kHz) and 4 high speed (max. 100 kHz) inputs.

The outputs include 4 high speed (push-pull) outputs with a maximum current of 100 mA, 4 standard (high-side) outputs with a maximum current of 400 mA and 2 low speed (high-side) outputs with a maximum current of 2 A. All outputs can be read.

2.8.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC130.60-1	ACOPOS plug-in module, 8 digital I/O configurable in pairs as 24V input or as output 400/100mA, 2 digital outputs 2A, Order TB712 terminal block separately	
	Accessories	
7TB712.9	Terminal block, 12 pin, screw clamps	
7TB712.91	Terminal block, 12 pin, cage clamps	
7TB712:90-02	Terminal block, 12 pin, 20 pcs., screw clamps	
7TB712:91-02	Terminal block, 12 pin, 20 pcs., cage clamps	

Table 29: Order data for AC130

2.8.3 Technical Data

Product ID	8AC130.60-1
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot ¹⁾	Slots 2, 3 and 4
Power Consumption	Max. 0.8 W
Inputs/Outputs	
Connection, Module Side	12 conductor pin-connector
Configuration of the Inputs/Outputs	Can be configured in pairs as input or output
LEDs	24 V LED
Supply Voltage	
Power Supply	
Minimum	18 VDC
Nominal	24 VDC
Maximum	30 VDC
Reverse Polarity Protection	Yes
Voltage Monitoring (24 V - LED)	Yes, supply voltage > 18 V
Digital Inputs ²⁾	
Number of Inputs	Max. 8
Wiring	Sink
Electrical Isolation	
Input - ACOPOS	Yes
Input - Input	No
Input Voltage	
Nominal	24 VDC
Maximum	30 VDC
Switching Threshold	
LOW	< 5 V
HIGH	> 15 V
Input Current at Nominal Voltage	
Inputs 1 - 4	Approx. 10 mA
Inputs 5 - 8	Approx. 5.5 mA
Switching Delay	
Inputs 1 - 4	Max. 5 µs
Inputs 5 - 8	Max. 35 µs
Event Counter	
Signal Form	Square wave pulse
Input Frequency	Max. 100 kHz
Counter Size	16-bit
Inputs	
Input 1	Counter 1
Input 2	Counter 2

Table 30: Technical data for AC130

Product ID	8AC130.60-1
Incremental encoder	
Signal Form	Square wave pulse
Evaluation	4-fold
Encoder Monitoring	No
Input Frequency	Max. 62.5 kHz
Count Frequency	Max. 250 kHz
Reference Frequency	Max. 62.5 kHz
Distance between Edges	Min. 2.5 µs
Counter Size	16-bit
Inputs Input 1 Input 2 Input 3	Channel A Channel B Reference pulse R
Outputs	
Number of Outputs	Max. 10
Type Outputs 1 -4 Outputs 5 - 10	Transistor outputs Push-pull High-side
Electrical Isolation Output - ACOPOS Output - Output	Yes No
Switching Voltage Minimum Nominal Maximum	18 VDC 24 VDC 30 VDC
Continuous Current Outputs 1 -4 Outputs 5 -8 Outputs 9 - 10	Max. 100 mA Max. 400 mA Max. 2 A
Switching Delay 0 -> 1 and 1 -> 0 Outputs 1 -4 Outputs 5 -8 Outputs 9 - 10	Max. 5 µs Max. 50 µs Max. 500 µs
Switching Frequency (resistive load) Outputs 1 -2 Outputs 3 -4 Outputs 5 -8 Outputs 9 - 10	Max. 10 kHz (max. 20 kHz in PWM mode) Max. 10 kHz Max. 5 kHz Max. 100 Hz
PWM Outputs 1 - 2 Resolution of the Pulse Width Period Duration	13-bit 50 µs - 400 µs
Protection Short Circuit Protection Overload Protection	Yes Yes

Table 30: Technical data for AC130 (cont.)

Product ID	8AC130.60-1
Short Circuit Current at 24 V (until cut-off) Outputs 1 -4 Outputs 5 -8 Outputs 9 - 10	Approx. 1 A Approx. 1.2 A Approx. 24 A
Readable Outputs	Yes
Operational Conditions	
Environment Temperature during Operation	0 to +50 °C
Relative Humidity during Operation	5 to 95 %, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to +55 °C
Relative Humidity during Storage	5 to 95 %, non-condensing
Transport Temperature	-25 to +70 °C
Relative Humidity during Transport	95 % at +40 °C

Table 30: Technical data for AC130 (cont.)

- 1) The AC130 can also be used as an encoder module. Several encoder modules can also be inserted. In this case, the encoder module in the slot with the lowest number is automatically used for motor feedback.
- 2) Shielded cables must be used for inputs 1 - 4.

2.8.4 LEDs

The 24V LED is lit as soon as the supply voltage for the plug-in module goes above 18 VDC.

2.8.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

2.9 AC131 - Mixed Module

2.9.1 General Description

The AC131 plug-in module can be used in an ACOPOS slot. A maximum of 2 analog inputs (± 10 V differential inputs or single-ended inputs) and 2 digital inputs or digital outputs are available.

The analog inputs have a resolution of 12 bits and are scanned synchronously using the 50 μ s clock for the ACOPOS servo drive. The analog inputs have a 10 kHz analog input filter (low pass 3rd order).

The digital inputs and outputs can be configured individually as input or output. The digital inputs are equipped with a counter function. The digital outputs (push-pull) can be read.

2.9.2 Order Data

Model Number	Short Description	Image
	Plug-in Module	
8AC131.60-1	ACOPOS plug-in module, 2 analog inputs ± 10 V, 2 digital I/O points which can be configured as 24V input or 45mA output	
	Accessories	
7TB712.9	Terminal block, 12 pin, screw clamps	
7TB712.91	Terminal block, 12 pin, cage clamps	
7TB712.90-02	Terminal block, 12 pin, 20 pcs., screw clamps	
7TB712.91-02	Terminal block, 12 pin, 20 pcs., cage clamps	

Table 31: Order data for AC131

2.9.3 Technical Data

Product ID	8AC131.60-1
General Information	
C-UL-US Listed	Yes
Module Type	ACOPOS plug-in module
Slot	Slots 2, 3 and 4
Power Consumption	Max. 1 W
Inputs/Outputs	
Connection, Module Side	12 conductor pin-connector
Configuration of the Digital Inputs/Outputs	Can be configured individually as digital input or output
LEDs	24 V LED
Supply Voltage	
Power Supply Minimum Nominal Maximum	18 VDC 24 VDC 30 VDC
Reverse Polarity Protection	Yes
Voltage Monitoring (24 V - LED)	Yes, supply voltage > 18 V
Digital Inputs	
Number of Inputs	Max. 2
Wiring	Sink
Electrical isolation Input - ACOPOS Input - Input	Yes No
Input Voltage Minimum Nominal Maximum	18 VDC 24 VDC 30 VDC
Switching Threshold LOW HIGH	< 5 V > 15 V
Input Current at Nominal Voltage	Approx. 8 mA
Switching Delay Counters Digital Input	Max. 5 μ s Max. 55 μ s (digitally filtered)
Modulation Compared to Ground Potential	Max. $\pm$ 50 V
Event Counter	
Signal Form	Square wave pulse
Input Frequency	Max. 100 kHz
Counter Size	16-bit
Inputs Input 1 Input 2	Counter 1 Counter 2

Table 32: Technical data for AC131

Product ID	8AC131.60-1
Digital Outputs	
Number of Outputs	Max. 2
Type	Transistor outputs push-pull
Electrical Isolation	
Output - ACOPOS	Yes
Output - Output	No
Switching Voltage	
Minimum	18 VDC
Nominal	24 VDC
Maximum	30 VDC
Continuous Current	Max. 45 mA
Switching Delay 0 -> 1 and 1 -> 0	Max. 5 µs
Switching Frequency (resistive load)	Max. 100 kHz
Protection	
Short Circuit Protection	Yes
Overload Protection	Yes
Short Circuit Current at 24 V (until cut-off)	Approx. 0.3 A
Readable Outputs	Yes
Analog Inputs	
Number of Inputs	Max. 2
Design	Differential input or single ended input
Electrical Isolation	
Input - ACOPOS	Yes
Input - Input	No
Input Signal	
Nominal	-10 V to +10 V
Maximum	-15 V to +15 V
Operating mode	Cyclic measurement synchronous to 50 µs ACOPOS clock
Digital Converter Resolution	12-bit
Non-Linearity	±1 LSB
Output Format	INT16 \$8000 - \$7FF01 LSB = \$0010 = 4.883 mV
Conversion Procedure	Successive approximation
Conversion Time for both Inputs	< 50 µs
Differential Input Impedance	>10 MΩ
Input Filter	Analog low pass 3rd order / cut-off frequency: 10 kHz
Basic Accuracy at 25 °C	±0.05 % ¹⁾
Offset Drift	Max. ±0.0005 % / °C ¹⁾
Gain Drift	Max. ±0.006 % / °C ¹⁾
Cross-talk between the Analog Inputs	Min. -90 dB at 1kHz
Common-Mode Rejection	
DC	Min. -73 dB
50 Hz	Min. -73 dB

Table 32: Technical data for AC131 (cont.)

Product ID	8AC131.60-1
Modulation Compared to Ground Potential	Max. ± 50 V
Modulation between the Analog Input Channels	Max. ± 5 V
Operational Conditions	
Environment Temperature during Operation	0 to $+50$ °C
Relative Humidity during Operation	5 to 95 %, non-condensing
Storage and Transport Conditions	
Storage Temperature	-25 to $+55$ °C
Relative Humidity during Storage	5 to 95 %, non-condensing
Transport Temperature	-25 to $+70$ °C
Relative Humidity during Transport	95 % at $+40$ °C

Table 32: Technical data for AC131 (cont.)

1) Refers to the measurement range limit.

2.9.4 LEDs

The 24V LED is lit as soon as the supply voltage for the plug-in module goes above 18 VDC.

2.9.5 Firmware

The firmware is part of the operating system for the ACOPOS servo drives. The firmware is updated by updating the ACOPOS operating system.

3. Cables

3.1 General Information

B&R offers the cables for ACOPOS servo drives in six different lengths. All cables can be used for drag chain installations. ¹⁾

To prevent disturbances to encoder signals, the holding brake and temperature sensor wires are in the motor cable and not in the EnDat or resolver cable.

3.1.1 Prefabricated Cables

Using B&R cables guarantees that the EMC limits are not exceeded. The cables are prefabricated in the EU and are therefore subject to the strictest quality standards.

Information:

If other cables are used, make sure that they have the same wave parameters. If deviations exist, additional measures are necessary to ensure that EMC guidelines are met.

¹⁾ Custom fabrication of motor cables is available on request. For custom fabrication of motor cables, the plug size must be matched to the motor used!

3.2 Motor Cables

3.2.1 Order Data

Model Number	Short Description	Image
Motor Cables 1.5 mm ² 1)		
8CM005.12-1	Motor cable, length 5m, 4 x 1.5mm ² + 2 x 2 x 0.75mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM007.12-1	Motor cable, length 7m, 4 x 1.5mm ² + 2 x 2 x 0.75mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM010.12-1	Motor cable, length 10m, 4 x 1.5mm ² + 2 x 2 x 0.75mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM015.12-1	Motor cable, length 15m, 4 x 1.5mm ² + 2 x 2 x 0.75mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM020.12-1	Motor cable, length 20m, 4 x 1.5mm ² + 2 x 2 x 0.75mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM025.12-1	Motor cable, length 25m, 4 x 1.5mm ² + 2 x 2 x 0.75mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
Motor Cables 4 mm ² 2)		
8CM005.12-3	Motor cable, length 5m, 4 x 4mm ² + 2 x 2 x 1mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM007.12-3	Motor cable, length 7m, 4 x 4mm ² + 2 x 2 x 1mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM010.12-3	Motor cable, length 10m, 4 x 4mm ² + 2 x 2 x 1mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM015.12-3	Motor cable, length 15m, 4 x 4mm ² + 2 x 2 x 1mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM020.12-3	Motor cable, length 20m, 4 x 4mm ² + 2 x 2 x 1mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM025.12-3	Motor cable, length 25m, 4 x 4mm ² + 2 x 2 x 1mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
Motor Cables 10 mm ² 3)		
8CM005.12-5	Motor cable, length 5m, 4 x 10mm ² + 2 x 2 x 1.5mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM007.12-5	Motor cable, length 7m, 4 x 10mm ² + 2 x 2 x 1.5mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM010.12-5	Motor cable, length 10m, 4 x 10mm ² + 2 x 2 x 1.5mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM015.12-5	Motor cable, length 15m, 4 x 10mm ² + 2 x 2 x 1.5mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM020.12-5	Motor cable, length 20m, 4 x 10mm ² + 2 x 2 x 1.5mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	
8CM025.12-5	Motor cable, length 25m, 4 x 10mm ² + 2 x 2 x 1.5mm ² , Motor connector 8pin Intercontec socket, can be used in cable drag chains, UL/CSA listed	

Table 33: Order data for motor cables

Model Number	Short Description	Image
	Motor Cables 35 mm²	
8CM005.12-8	Motor cable, length 5m, 4 x 35mm ² + 2 x 2 x 1.5mm ² , can be used in cable drag chains, UL/CSA listed	
8CM007.12-8	Motor cable, length 7m, 4 x 35mm ² + 2 x 2 x 1.5mm ² , can be used in cable drag chains, UL/CSA listed	
8CM010.12-8	Motor cable, length 10m, 4 x 35mm ² + 2 x 2 x 1.5mm ² , can be used in cable drag chains, UL/CSA listed	
8CM015.12-8	Motor cable, length 15m, 4 x 35mm ² + 2 x 2 x 1.5mm ² , can be used in cable drag chains, UL/CSA listed	
8CM020.12-8	Motor cable, length 20m, 4 x 35mm ² + 2 x 2 x 1.5mm ² , can be used in cable drag chains, UL/CSA listed	
8CM025.12-8	Motor cable, length 25m, 4 x 35mm ² + 2 x 2 x 1.5mm ² , can be used in cable drag chains, UL/CSA listed	

Table 33: Order data for motor cables (cont.)

- 1) Standard fabrication; designed for use with ACOPOS servo drives 8V1022.00-x, 8V1045.00-x and 8V1090.00-x and motor sizes 2 to 7.
- 2) Standard fabrication; designed for use with ACOPOS servo drives 8V1180.00-x and 8V1320.00-x and motor sizes 2 to 7.
- 3) Standard fabrication; designed for use with ACOPOS servo drives 8V1640.00-x and 8V128M.00-x and motor size 8.

3.2.2 Technical Data

1.5 and 4 mm² motor cables

Description	Motor Cables 1.5 mm²	Motor Cables 4 mm²
General Information		
Cable Cross Section	4 x 1.5 mm² + 2 x 2 x 0.75 mm²	4 x 4 mm² + 2 x 2 x 1 mm²
Durability	Oil resistant according to VDE 0472 part 803, as well as standard hydraulic oil	
Certification	UL AWM Style 20669, 90 °C, 600 V, E63216 and CSA AWM I/II A/B, 90 °C, 600 V, FT1 LL46064	
Conductor		
Power Lines	1.5 mm², tinned Cu wire	4 mm², tinned Cu wire
Wire Insulation	Special thermoplastic material	
Wire Colors	Black, brown, blue, yellow/green	
Signal Lines	0.75 mm², tinned Cu wire	1 mm², tinned Cu wire
Wire Insulation	Special thermoplastic material	
Wire Colors	White, white/red, white/blue, white/green	
Cable Structure		
Power Lines	No No	
Stranding		
Shield		
Signal Lines	White with white/red and white/blue with white/green Separate shielding for pairs, tinned Cu mesh, optical coverage > 85 % and foil banding	
Stranding		
Shield		
Cable Stranding	With filler elements and foil banding	
Cable Shielding	Tinned Cu mesh, optical coverage > 85 % and wrapped in isolating fabric	
Outer Sheathing	PUR Orange, similar to RAL 2003 flat BERNECKER + RAINER 4x1.5+2x2x0.75 FLEX BERNECKER + RAINER 4x4.0+2x2x1.5 FLEX	
Material		
Color		
Labeling		
Electrical Characteristics		
Conductor Resistance	≤ 14 Ω/km ≤ 29 Ω/km ≤ 5.2 Ω/km ≤ 14 Ω/km	
Power Lines		
Signal Lines		
Insulation Resistance	> 200 MΩ per km	
Isolation Voltage	3 kV 1 kV	
Wire/Wire		
Wire/Shield		
Operating Voltage	Max. 600 V	
Mechanical Characteristics		
Temperature Range	-10 °C to +70 °C -20 °C to +90 °C	
Moving		
Static		
Outer Diameter	12.8 mm ± 0.4 mm	15.8 mm ± 0.5 mm
Flex Radius	> 96 mm	> 118.5 mm
Speed	≤ 4 m/s	
Acceleration	< 60 m/s²	
Flex Cycles	≥ 3,000,000	
Weight	0.26 kg/m	0.45 kg/m

Table 34: Technical data for motor cables 1.5 and 4 mm²

10 and 35 mm² motor cables

Description	Motor Cables 10 mm ²	Motor Cables 35 mm ²
General Information		
Cable Cross Section	4 x 10 mm ² + 2 x 2 x 1.5 mm ²	4 x 35 mm ² + 2 x 2 x 1.5 mm ²
Durability	Oil resistant according to VDE 0472 part 803, as well as standard hydraulic oil	
Certification	UL AWM Style 20669, 90 °C, 600 V, E63216 and CSA AWM I/II A/B, 90 °C, 600 V, FT1 LL46064	
Conductor		
Power Lines	10 mm ² , tinned Cu wire	35 mm ² , tinned Cu wire
Wire Insulation	Special thermoplastic material	
Wire Colors	Black, brown, blue, yellow/green	
Signal Lines	1.5 mm ² , tinned Cu wire	
Wire Insulation	Special thermoplastic material	
Wire Colors	White, white/red, white/blue, white/green	
Cable Structure		
Power Lines	No No	
Stranding		
Shield		
Signal Lines	White with white/red and white/blue with white/green	
Stranding	Separate shielding for pairs, tinned Cu mesh, optical coverage > 85 % and foil banding	
Shield		
Cable Stranding	With filler elements and foil banding	
Cable Shielding	Tinned Cu mesh, optical coverage > 85 % and wrapped in isolating fabric	
Outer Sheathing	PUR Orange, similar to RAL 2003 flat BERNECKER + RAINER 4x10.0+2x2x1.5 FLEX BERNECKER + RAINER 4x35.0+2x2x1.5 FLEX	
Material		
Color		
Labeling		
Electrical Characteristics		
Conductor Resistance	≤ 2.1 Ω/km ≤ 14 Ω/km	
Power Lines		
Signal Lines		
Insulation Resistance	> 200 MΩ per km	
Isolation Voltage	3 kV 1 kV	
Wire/Wire		
Wire/Shield		
Operating Voltage	Max. 600 V	
Mechanical Characteristics		
Temperature Range	-10 °C to +70 °C -20 °C to +90 °C	
Moving		
Static		
Outer Diameter	20.1 mm ± 0.7 mm	32.5 mm ± 1 mm
Flex Radius	> 150.8 mm	> 243.8 mm
Speed	≤ 4 m/s	
Acceleration	< 60 m/s ²	
Flex Cycles	≥ 3,000,000	
Weight	0.77 kg/m	2.2 kg/m

 Table 35: Technical data for motor cables 10 and 35 mm²

3.3 EnDat Cable

3.3.1 Order Data

Model Number	Short Description	Image
8CE005.12-1	EnDat cable, length 5m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE007.12-1	EnDat cable, length 7m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE010.12-1	EnDat cable, length 10m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE015.12-1	EnDat cable, length 15m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE020.12-1	EnDat cable, length 20m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CE025.12-1	EnDat cable, length 25m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	

Table 36: Order data for EnDat cables

3.3.2 Technical Data

Description	EnDat Cables
General Information	
Cable Cross Section	10 x 0.14 mm ² + 2 x 0.50 mm ²
Durability	Oil resistant according to VDE 0472 part 803, as well as standard hydraulic oil
Certification	UL AWM Style 20963, 80 °C, 30 V, E63216 and CSA AWM I/II A/B, 90 °C, 30 V, FT1 LL46064
Conductor	
Signal Lines Wire Insulation Wire Colors	0.14 mm ² , tinned Cu wire Special thermoplastic material Blue, brown, yellow, gray, green, pink, red, black, violet, white
Supply Lines Wire Insulation Wire Colors	0.5 mm ² , tinned Cu wire Special thermoplastic material White/green, white/red
Cable Structure	
Signal Lines Stranding Shield	No No
Supply Lines Stranding Shield	White/red with white/green and filler elements No
Cable Stranding	With foil banding

Table 37: Technical data for EnDat cables

Description	EnDat Cables
Cable Shielding	Cu mesh, optical coverage > 85 % and wrapped in isolating fabric
Outer Sheathing Material Color Labeling	PUR Orange, similar to RAL 2003 flat BERNECKER + RAINER 10x0.14+2x0.50 FLEX
Electrical Characteristics	
Conductor Resistance Signal Lines Supply Lines	$\leq 140 \Omega/\text{km}$ $\leq 40 \Omega/\text{km}$
Insulation Resistance	> 200 M Ω per km
Isolation Voltage Wire/Wire Wire/Shield	1.5 kV 0.8 kV
Operating Voltage	Max. 30 V
Mechanical Characteristics	
Temperature Range Moving Static	-10 °C to +70 °C -20 °C to +90 °C
Outer Diameter	7.3 mm $\pm$ 0.25 mm
Flex Radius	> 55 mm
Speed	$\leq 4 \text{ m/s}$
Acceleration	< 60 m/s ²
Flex Cycles	$\geq 3,000,000$
Weight	0.08 kg/m

Table 37: Technical data for EnDat cables (cont.)

3.4 Resolver Cable

3.4.1 Order Data

Model Number	Short Description	Image
8CR005.12-1	Resolver cable, length 5m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR007.12-1	Resolver cable, length 7m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR010.12-1	Resolver cable, length 10m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR015.12-1	Resolver cable, length 15m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR020.12-1	Resolver cable, length 20m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	
8CR025.12-1	Resolver cable, length 25m, 3 x 2 x 24 AWG/19, resolver plug 12-pin Intercontec socket, servo plug 9-pin DSUB plug, can be used in cable drag chains, UL/CSA listed	

Table 38: Order data for resolver cables

3.4.2 Technical Data

Description	Resolver Cables
General Information	
Cable Cross Section	3 x 2 x 24 AWG/19
Durability	Oil resistant according to VDE 0472 part 803, as well as standard hydraulic oil
Certification	UL AWM Style 20671, 90 °C, 30 V, E63216 and CSA AWM, 90 °C, 30 V, I/II A/B FT1 LL46064
Conductor	
Signal Lines Wire Insulation Wire Colors	24 AWG/19, tinned Cu wire Special thermoplastic material White, brown, green, yellow, gray, pink
Cable Structure	
Signal Lines Stranding Shield	White with brown, green with yellow, gray with pink No
Cable Stranding	The 3 pairs together covered by foil banding
Cable Shielding	Cu mesh, optical coverage $\geq 90\%$ and wrapped in isolating fabric
Outer Sheathing Material Color Labeling	PUR Orange, similar to RAL 2003 flat BERNECKER + RAINER 3x2x24 AWG FLEX

Table 39: Technical data for resolver cables

Description	Resolver Cables
Electrical Characteristics	
Conductor Resistance 24 AWG	$\leq 86 \Omega/\text{km}$
Insulation Resistance	$> 200 \text{ M}\Omega \text{ per km}$
Isolation Voltage Wire/Wire Wire/Shield	1.5 kV 0.8 kV
Operating Voltage	Max. 30 V
Mechanical Characteristics	
Temperature Range Moving Static	-10 °C to +80 °C -40 °C to +90 °C
Outer Diameter	6.5 mm $\pm$ 0.2 mm
Flex Radius	$\geq 50 \text{ mm}$
Speed	$\leq 4 \text{ m/s}$
Acceleration	$< 60 \text{ m/s}^2$
Flex Cycles	$\geq 3,000,000$
Weight	0.07 kg/m

Table 39: Technical data for resolver cables (cont.)

4. Connectors

4.1 General Information

B&R offers five different motor/encoder connectors for AC servo motors. All connectors have IP67 protection. The metallic housing provides a protective ground connection on the housing according to VDE 0627. All plastic used in the connector is UL94/V0 listed. High quality, gold plated cage connector contacts guarantee a high level of contact security even when reinserted many times.

Using B&R connectors guarantees that the EMC limits for the connection are not exceeded. Make sure that connectors are put together correctly including a proper shield connection.

4.2 Motor Connectors

4.2.1 Order Data

Model Number	Short Description	Image
	Cable Diameter 9 - 17 mm	
8PM001.00-1	Motor plug 8-pin Intercontec socket, crimp range 4 x 0.5-2.5mm ² + 4 x 0.06-1.0mm ² , for cable ø 9-14mm, IP67, UL/CSA listed	 4 x  4 x 
8PM002.00-1	Motor plug 8-pin Intercontec socket, crimp range 4 x 2.5-4.0mm ² + 4 x 0.06-1.0mm ² , for cable ø 14-17mm, IP67, UL/CSA listed	
	Cable Diameter 17 - 26 mm	
8PM003.00-1	Motor plug 8-pin Intercontec socket, crimp range 4 x 1.5-10mm ² + 4 x 0.5-2.5mm ² , for cable ø 17-26mm, IP67, UL/CSA listed	 4 x  4 x 

Table 40: Order data for motor connectors

4.2.2 Technical Data for 8PM001.00-1 and 8PM002.00-1

Product ID	8PM001.00-1	8PM002.00-1
General Information		
Connector Size	Size 1	
Contacts	8 (4 power and 4 signal contacts)	
Degree of Pollution	3	
Installation Altitude	Up to 2,000 m	
Insulator	PA 6.6 / PBT, UL94/V0 listed	
Contacts	Gold plated brass	
Protective Ground Connection on Housing	According to VDE 0627	
Protection according to DIN 40050	IP67 when connected	
Certifications	UL/CSA	
Electrical Characteristics		
Overvoltage Category	3	
Power Contacts Nominal Current Nominal Voltage Isolation Voltage (L-L) Contact Resistance	30 A 630 VAC / VDC 6000 V < 3 mΩ	
Signal Contacts Nominal Current Nominal Voltage Isolation Voltage (L-L) Contact Resistance	10 A 250 VAC / VDC 2500 V < 5 mΩ	
Mechanical Characteristics		
Temperature Range	-20 °C to +130 °C	
Housing Material	Zinc die cast / brass, nickel plated	
Gaskets	FPM / HNBR	
Mating Cycles	> 50	
Crimp Range	4 x 0.5 - 2.5 mm² + 4 x 0.06 - 1 mm²	4 x 0.5 -4 mm² + 4 x 0.06 - 1 mm²
Cable ø	9.5 -14.5 mm	14 -17 mm
Manufacturer Information		
Manufacturer Internet Address	INTERCONTEC www.intercontec.biz	
Manufacturer's Product ID	BSTA 108 FR 19 58 0036 000	BSTA 108 FR 35 59 0036 000

Table 41: Technical data for motor connectors 8PM001.00-1 and 8PM002.00-1

4.2.3 Technical Data for 8PM003.00-1

Product ID	8PM003.00-1
General Information	
Connector Size	Size 1.5
Contacts	8 (4 power and 4 signal contacts)
Degree of Pollution	3
Installation Altitude	Up to 2,000 m
Insulator	PA 6.6 / PBT, UL94/V0 listed
Contacts	Gold plated brass
Protective Ground Connection on Housing	According to VDE 0627
Protection according to DIN 40050	IP67 when connected
Certifications	UL/CSA
Electrical Characteristics	
Overvoltage Category	3
Power Contacts Nominal Current Nominal Voltage Isolation Voltage (L-L) Contact Resistance	75 A 630 VAC / VDC 6000 V < 1 mΩ
Signal Contacts Nominal Current Nominal Voltage Isolation Voltage (L-L) Contact Resistance	30 A 630 VAC / VDC 4000 V < 3 mΩ
Mechanical Characteristics	
Temperature Range	-20 °C to +130 °C
Housing Material	Magnesium die cast / aluminum, nickel plated
Gaskets	FPM / HNBR
Mating Cycles	> 50
Crimp Range	4 x 1.5 - 10 mm² + 4 x 0.5 - 2.5 mm²
Cable ø	17 - 26 mm
Manufacturer Information	
Manufacturer Internet Address	INTERCONTEC www.intercontec.biz
Manufacturer's Product ID	CSTA 264 FR 48 25 0001 000

Table 42: Technical data for motor connector 8PM003.00-1

4.3 Encoder Connectors

4.3.1 Order Data

Model Number	Short Description	Image
EnDat Connector		 17 x 
8PE001.00-1	EnDat Connector 17 pin Intercontec socket, crimp range 17 x 0.06-1,0mm², for cable ø 9-12mm, IP67, UL/CSA listed	
Resolver Connector		 12 x 
8PR001.00-1	Resolver connector 12 pin Intercontec socket, crimp range 12 x 0.06-1,0mm², for cable ø 5.5-10.5mm, IP67, UL/CSA listed	

Table 43: Order data for encoder connectors

4.3.2 Technical Data for EnDat Connector 8PE001.00-1

Product ID	8PE001.00-1
General Information	
Connector Size	Size 1
Contacts	17 signal contacts
Degree of Pollution	3
Installation Altitude	Up to 2,000 m
Insulator	PA 6.6 / PBT, UL94/V0 listed
Contacts	Gold plated brass
Protective Ground Connection on Housing	According to VDE 0627
Protection according to DIN 40050	IP67 when connected
Certifications	UL/CSA
Electrical Characteristics	
Overvoltage Category	3
Signal Contacts	
Nominal Current	9 A
Nominal Voltage	125 V
Isolation Voltage (L-L)	2500 V
Contact Resistance	< 5 mΩ
Mechanical Characteristics	
Temperature Range	-20 °C to +130 °C
Housing Material	Zinc die cast / brass, nickel plated
Gaskets	FPM / HNBR
Mating Cycles	> 50
Crimp Range	17 x 0.06 - 1 mm²
Cable ø	9 -12 mm
Manufacturer Information	
Manufacturer	INTERCONTEC
Internet Address	www.intercontec.biz
Manufacturer's Product ID	ASTA 035 FR 11 12 0035 000

Table 44: Technical data for EnDat connector 8PE001.00-1

4.3.3 Technical Data for Resolver Connector 8PR001.00-1

Product ID	8PR001.00-1
General Information	
Connector Size	Size 1
Contacts	12 signal contacts
Degree of Pollution	3
Installation Altitude	Up to 2,000 m
Insulator	PA 6.6 / PBT, UL94/V0 listed
Contacts	Gold plated brass
Protective Ground Connection on Housing	According to VDE 0627
Protection according to DIN 40050	IP67 when connected
Certifications	UL/CSA
Electrical Characteristics	
Overvoltage Category	3
Signal Contacts	
Nominal Current	9 A
Nominal Voltage	160 V
Isolation Voltage (L-L)	2500 V
Contact Resistance	< 5 mΩ
Mechanical Characteristics	
Temperature Range	-20 °C to +130 °C
Housing Material	Zinc die cast / brass, nickel plated
Gaskets	FPM / HNBR
Mating Cycles	> 50
Crimp Range	12 x 0.06 - 1 mm²
Cable ø	5.5 -10.5 mm
Manufacturer Information	
Manufacturer	INTERCONTEC
Internet Address	www.intercontec.biz
Manufacturer's Product ID	ASTA 021 FR 11 10 0035 000

Table 45: Technical data for resolver connector 8PR001.00-1

Chapter 3 • Installation

1. General Information

Make sure that installation takes place on a flat surface which is correctly dimensioned. The dimensional diagram lists the number and type of mounting screws to be used.

The eye bolt contained in the delivery can be attached to the device to lift ACOPOS 1640 and ACOPOS 128M drives:

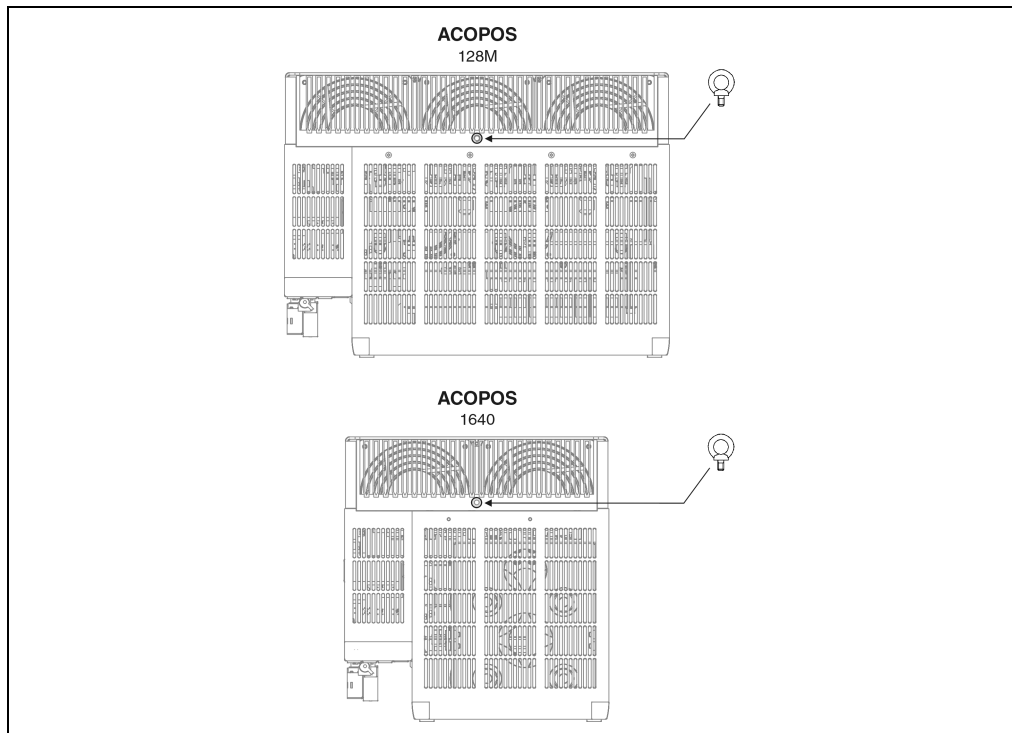


Figure 12: Attaching the eye bolt contained in the delivery to ACOPOS 1640 and 128M drives

ACOPOS servo drives can only be installed in an environment which corresponds to pollution degree II (non-conductive material). When installing the device, make sure that the maximum operating temperature (40 °C) is not exceeded and IP20 protection is provided as specified in the technical data.

For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive. ACOPOS servo drives can be mounted directly next to each other; the required distance between devices can be found in the respective dimensional diagram.

2. Dimensional Diagrams and Installation Dimensions

2.1 ACOPOS 1022, 1045, 1090

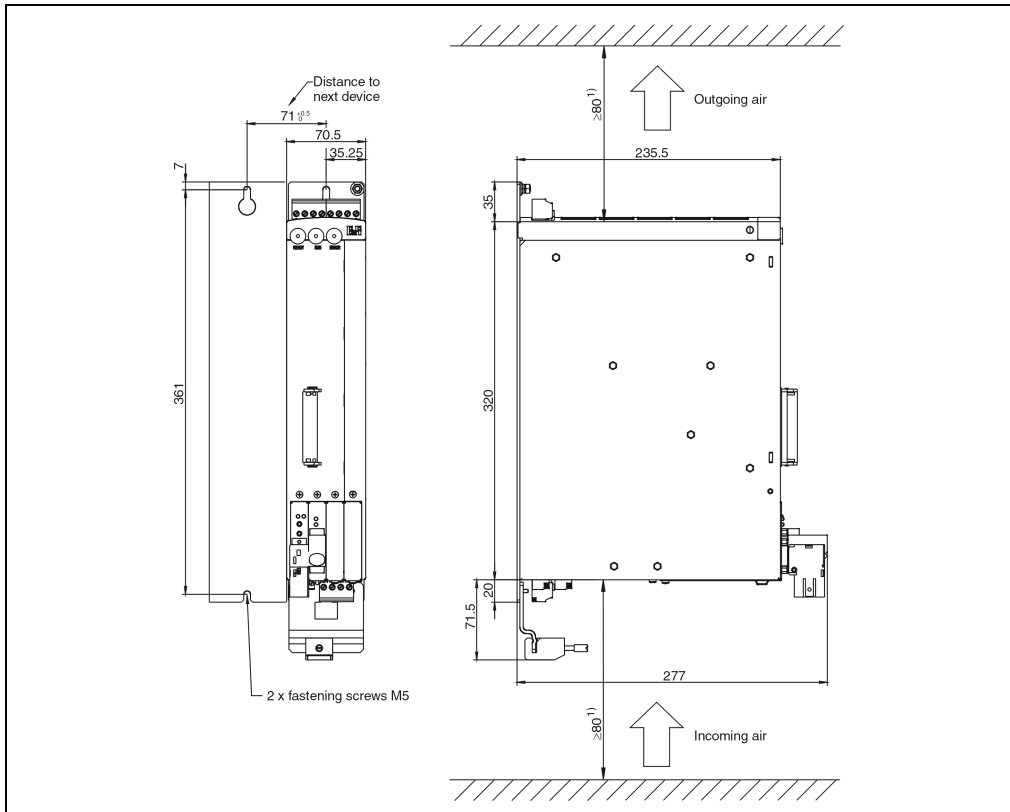


Figure 13: Dimensional diagram and installation dimensions for ACOPOS 1022, 1045, 1090

- 1) For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive.

2.2 ACOPOS 1180, 1320

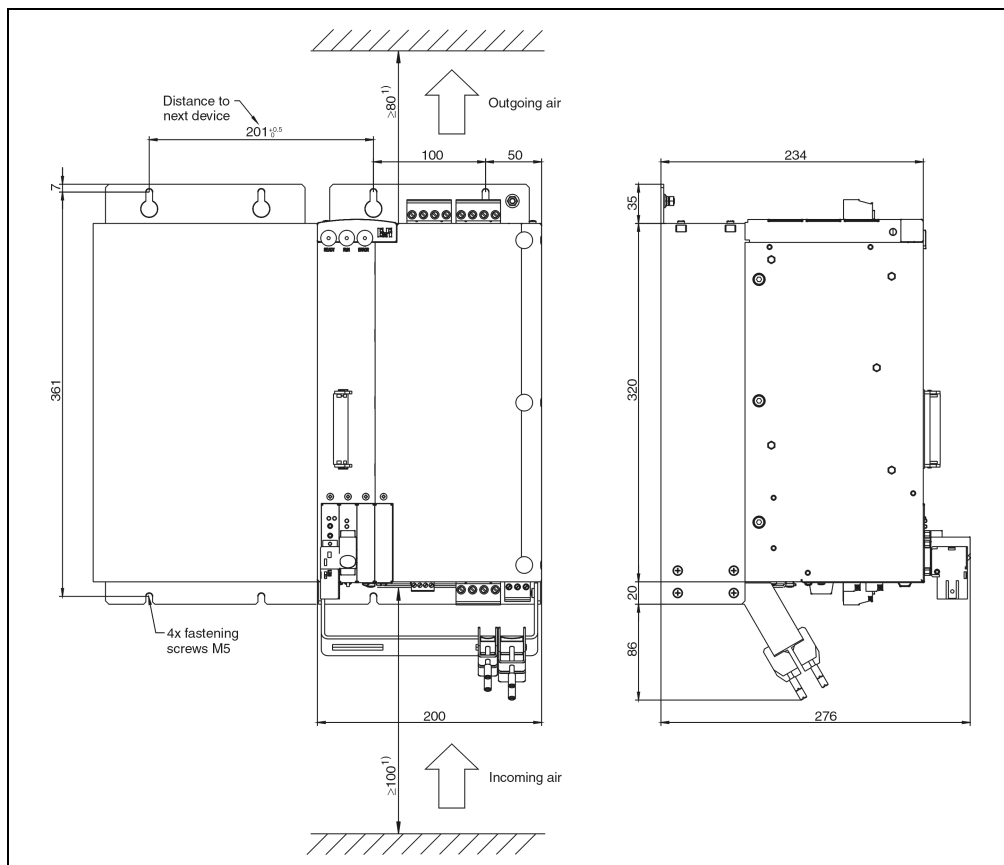


Figure 14: Dimensional diagram and installation dimensions for ACOPOS 1180, 1320

- 1) For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive. Approximately 100 mm free space is required under the ACOPOS servo drive to prevent cabling problems.

2.3 ACOPOS 1640

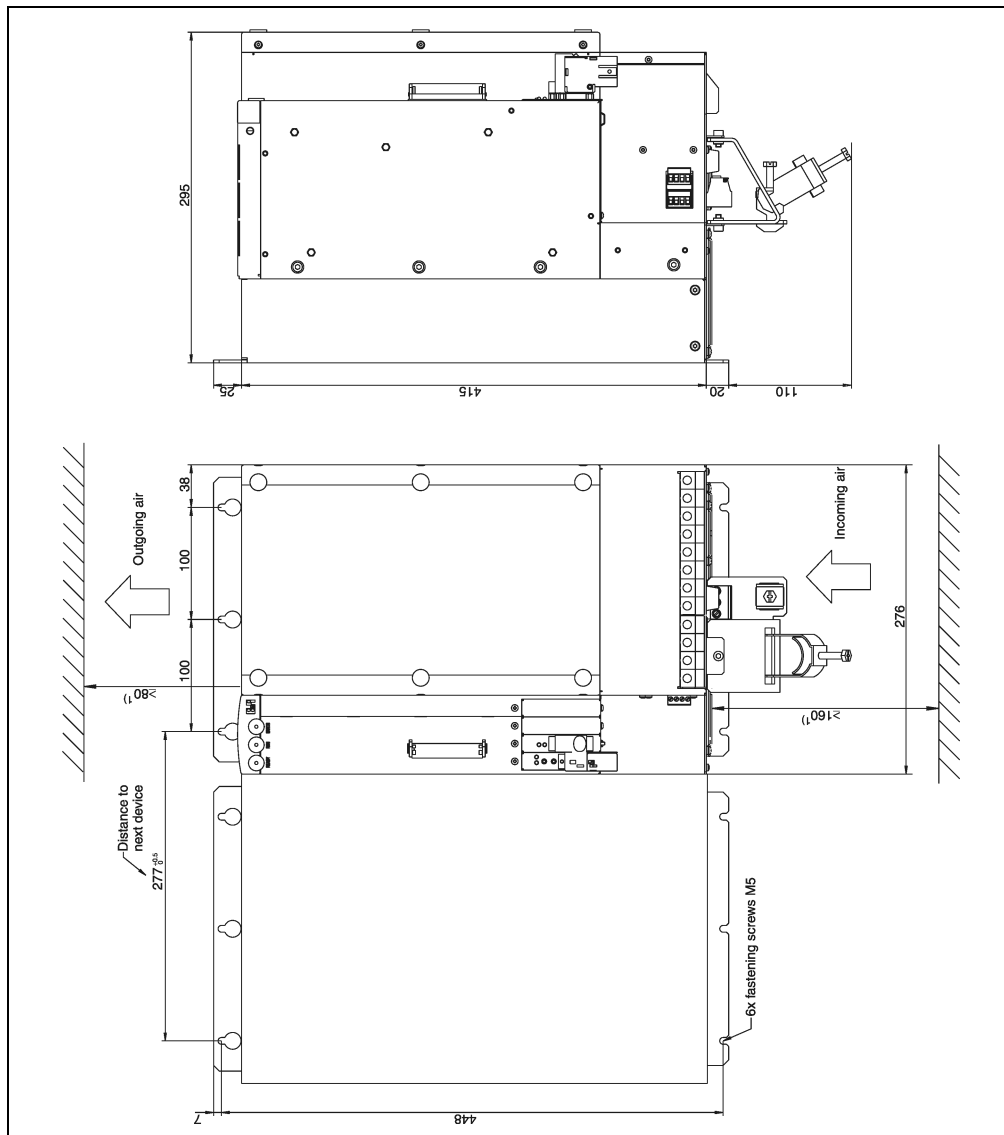


Figure 15: Dimensional diagram and installation dimensions for ACOPOS 1640

- 1) For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive. Approximately 160 mm free space is required under the ACOPOS servo drive to prevent cabling problems.

2.4 ACOPOS 128M

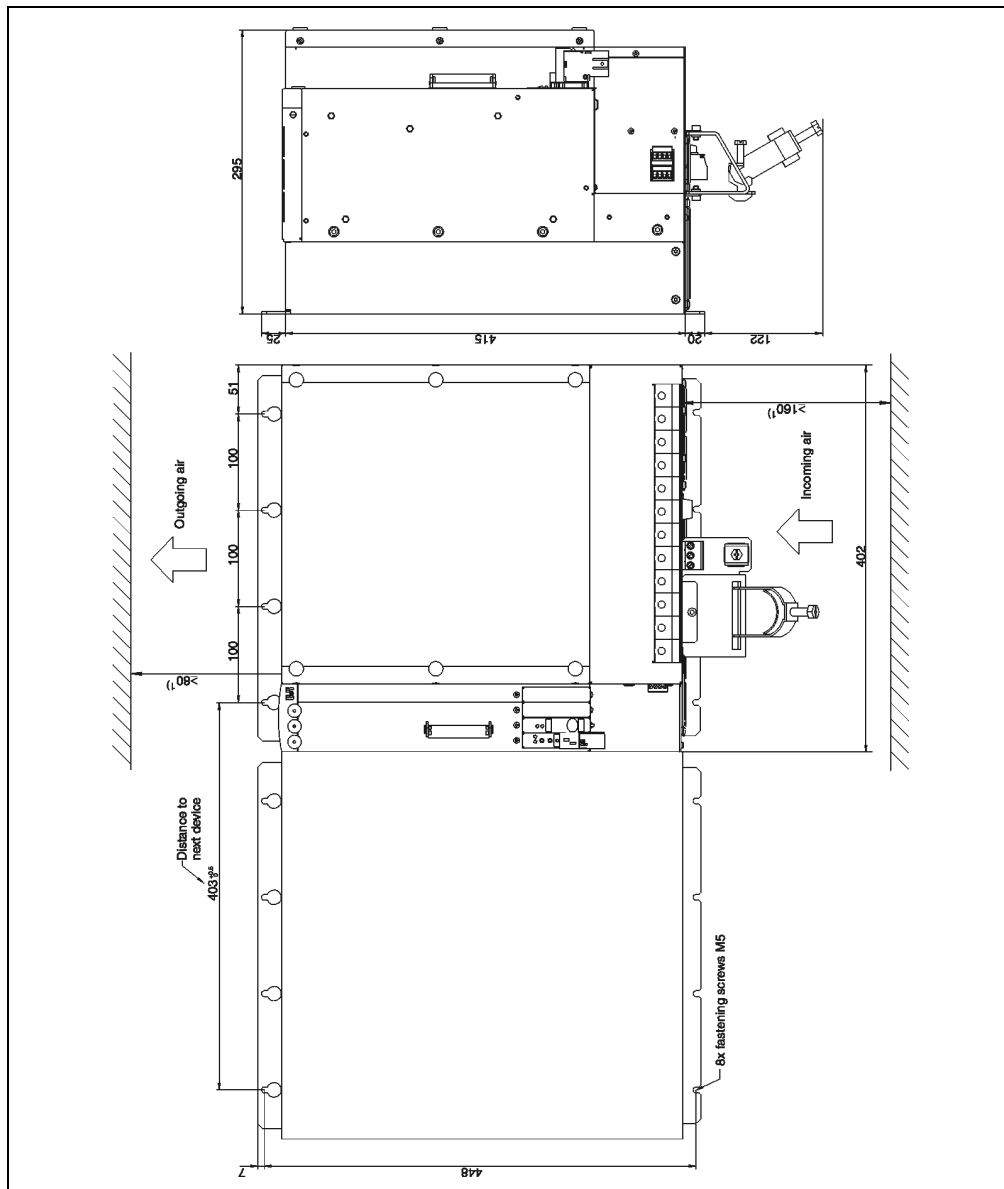


Figure 16: Dimensional diagram and installation dimensions for ACOPOS 128M

- 1) For proper air circulation, at least 80 mm has to be left free above and below the ACOPOS servo drive. Approximately 160 mm free space is required under the ACOPOS servo drive to prevent cabling problems.

3. Installation and Removal of Plug-in Modules

3.1 General Information

All ACOPOS servo drives are equipped with four slots for plug-in modules. At present, the following module arrangements must be used:

Image	Plug-in module	Operation possible in			
		Slot 1	Slot 2	Slot 3	Slot 4
	8AC110.60-2	Yes	No	No	No
	8AC112.60-1	Yes	No	No	No
	8AC120.60-1	No	Yes	Yes	Yes
	8AC122.60-2	No	Yes	Yes	Yes
	8AC123.60-1	No	Yes	Yes	Yes
	8AC130.60-1	No	Yes	Yes	Yes
	8AC131.60-1	No	Yes	Yes	Yes

Table 46: Slot overview for ACOPOS plug-in modules

Caution!

- Keep the plug-in modules in the original packaging and only take them out immediately before installation.
- Avoid touching the plug-in modules anywhere but on the front cover.
- Take the necessary steps to protect against electrostatic discharges.

3.2 Installation

- 1) Disconnect the ACOPOS servo drive from the power mains and prevent reconnection.
- 2) Switch off 24 VDC supply voltage.
- 3) Remove screw from the bottom of the slot cover.
- 4) Loosen screw on the front side.

- 5) Remove slot cover.



Figure 17: Installing ACOPOS plug-in modules

- 6) Insert plug-in module in the free slot (see figure shown above).
- 7) Fasten the plug-in module with the two screws.
- 8) Switch on 24 VDC supply voltage.
- 9) Connect ACOPOS servo drive to the power mains.

3.3 Removal

- 1) Disconnect the ACOPOS servo drive from the power mains and prevent reconnection.
- 2) Switch off 24 VDC supply voltage.
- 3) Remove screw from the bottom of the plug-in module.
- 4) Loosen screw on the front side.
- 5) Remove plug-in module.
- 6) Insert slot cover in free slot.
- 7) Fasten the slot cover with the two screws.
- 8) Switch on 24 VDC supply voltage.
- 9) Connect ACOPOS servo drive to the power mains.

4. Installing Various ACOPOS Series Devices Directly Next to Each Other

When installing various ACOPOS series devices directly next to each other, we recommend aligning the vertical position so that the LED displays of the respective devices are lined up.

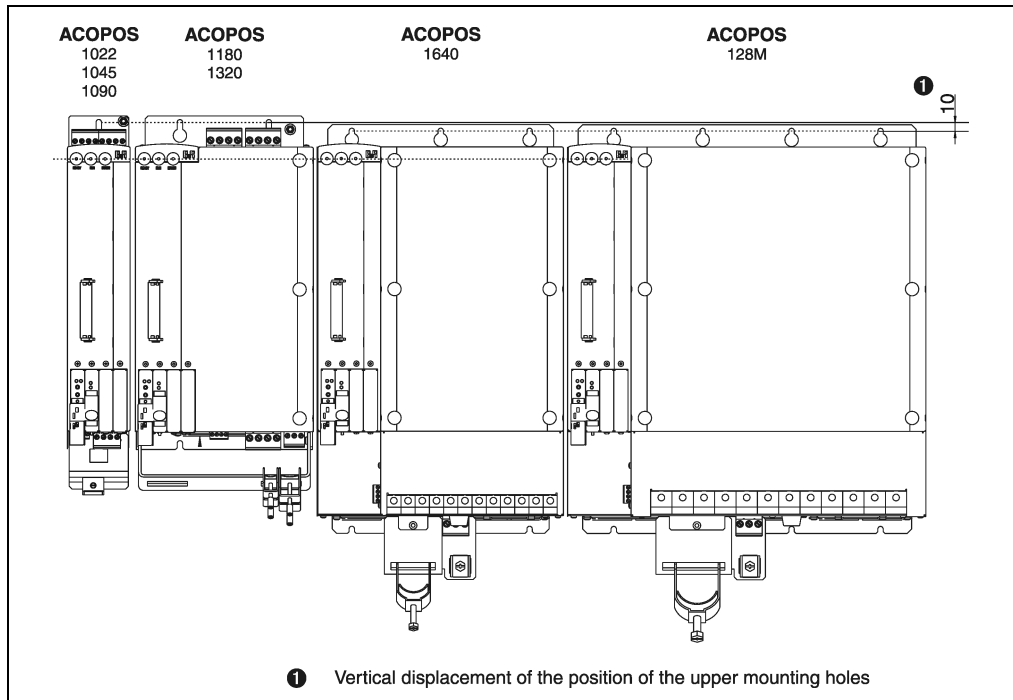


Figure 18: Installing various ACOPOS series devices directly next to each other

You can see from the image above that the vertical offset of the upper mounting holes is 10 mm. The distances for the lower mounting holes and the number and size of the screws required can be taken from the dimensional diagrams for the respective ACOPOS servo drives.

Overview of the vertical offsets:

Installed next to		ACOPOS						
		1022	1045	1090	1180	1320	1640	128M
ACOPOS	1022	No offset					10 mm	
	1045							
	1090							
	1180							
	1320							
	1640	10 mm					No offset	
	128M							

Table 47: Overview of the vertical offsets (ACOPOS - ACOPOS)

5. Using Cooling Aggregates in Switching Cabinets

5.1 General Information

To prevent exceeding the required environmental temperatures, it may be necessary to cool the air inside of a switching cabinet.

Caution!

Incorrect installation of cooling aggregates may cause condensation which can damage the ACOPOS servo drives installed there!

Condensation can enter the ACOPOS servo drives with the cooled air stream!

Make sure that only well sealed switching cabinets are used (condensation caused by outside air entering the switching cabinet).

During operation with the switching cabinet doors open (e.g. service), the ACOPOS servo drives are not allowed to be cooler than the air in the switching cabinet at any time after the doors are closed.

To keep the temperature of the ACOPOS servo drives and the switching cabinet at the same level, the cooling aggregate must remain in operation even when the system is switched off.

Cooling aggregates must be installed in a way that prevents condensation from dripping into the ACOPOS servo drives. This should be considered when selecting the switching cabinet (special construction for use of cooling aggregates on top of the switching cabinet).

Also make sure that condensed water which forms in the cooling aggregate fan when it is switched off cannot sprinkle into the ACOPOS servo drives.

Make sure the temperature setting of the cooling aggregates is correct!

5.2 Cooling Aggregate on Top of the Switching Cabinet

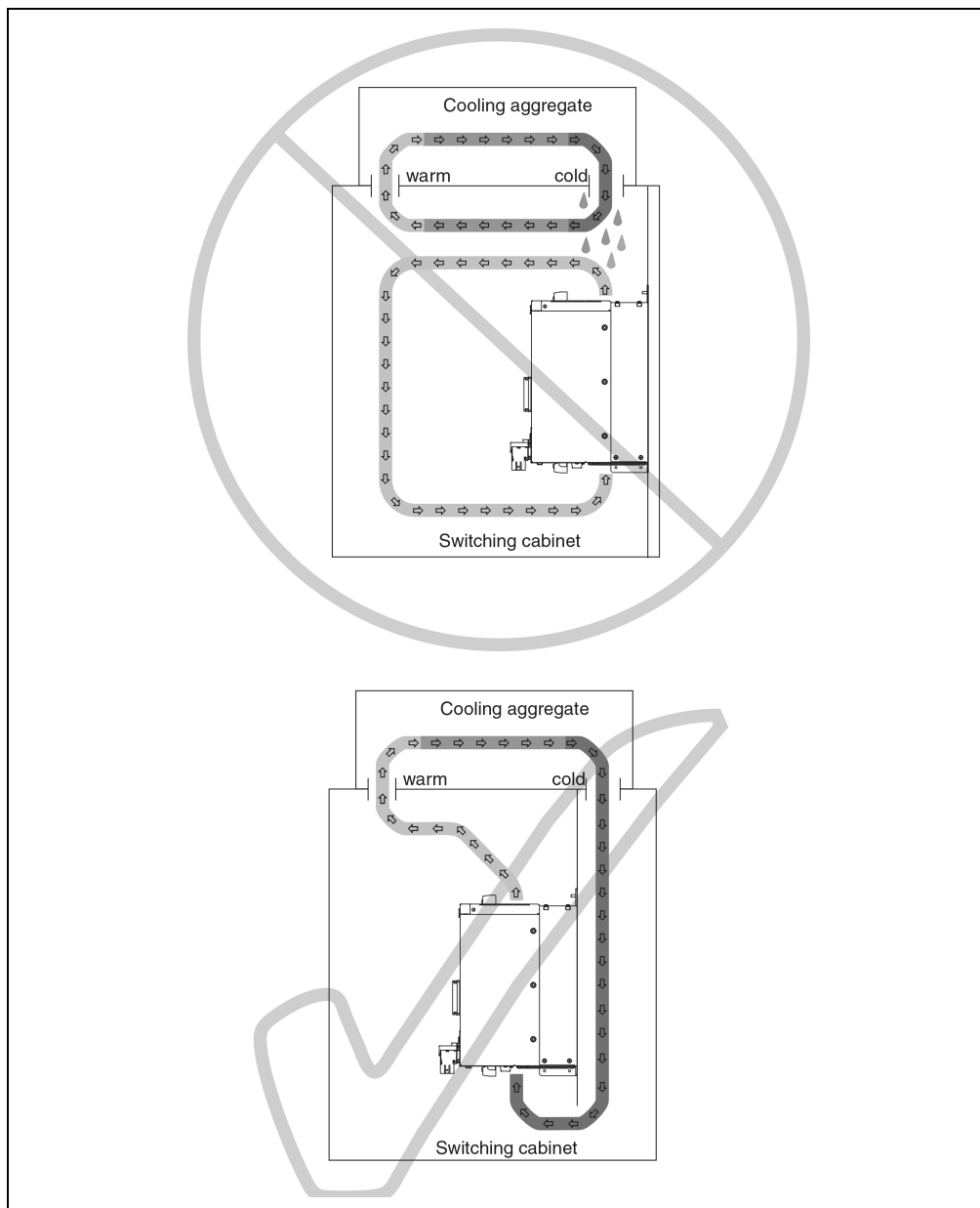


Figure 19: Cooling aggregate on top of the switching cabinet

5.3 Placing a Cooling Aggregate on the Front of the Switching Cabinet

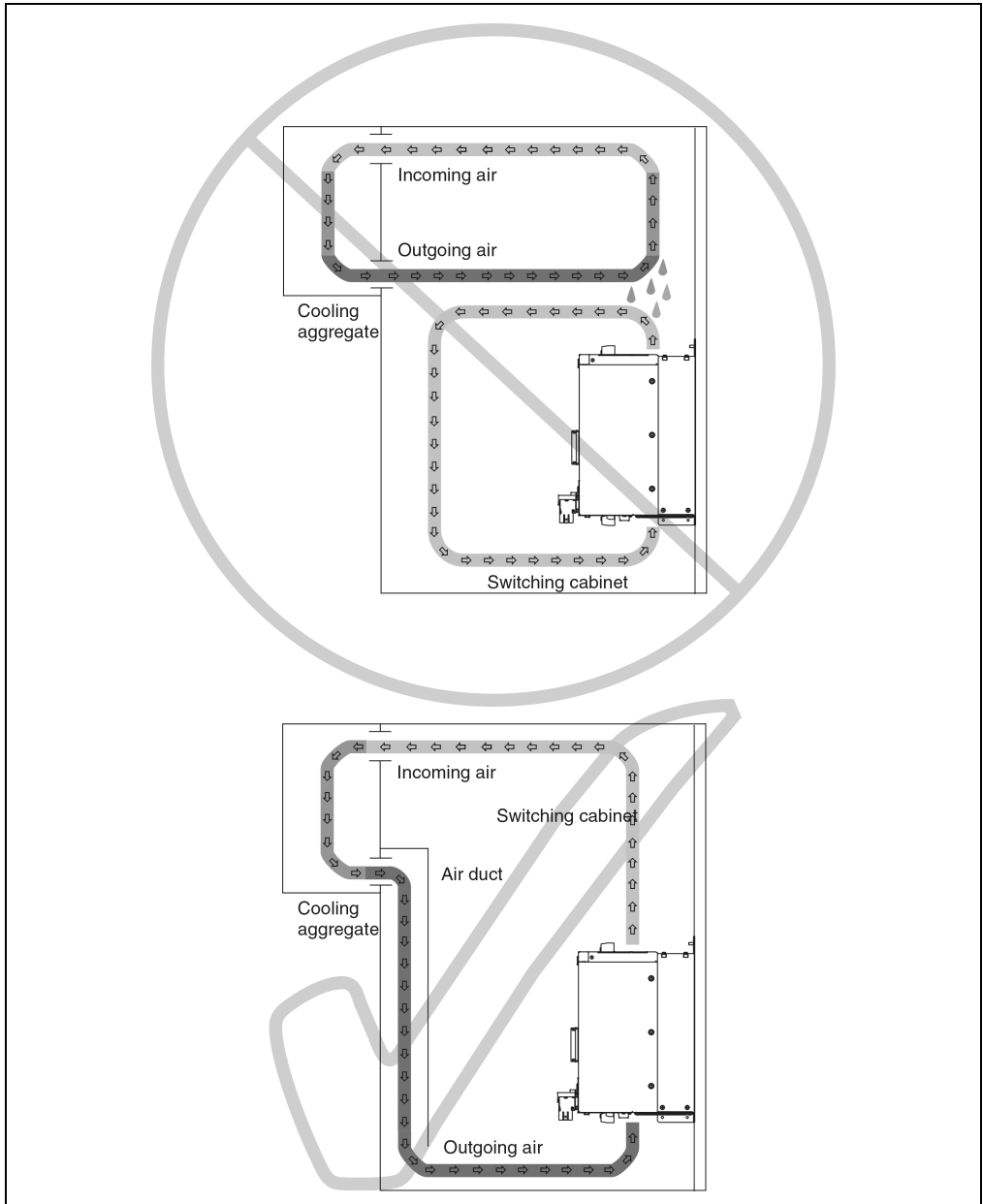


Figure 20: Placing a cooling aggregate on the front of the switching cabinet

Chapter 4 • Dimensioning

1. Power Mains Connection

1.1 General Information

1.1.1 System Configuration

The power mains connection is made using terminals X3 / L1, L2, L3 and PE. The ACOPOS servo drives can be directly connected to TT and TN systems (these are three-phase systems with grounded neutral).

When using ungrounded IT systems (three-phase systems without grounded neutral), isolation transformers must be used. The secondary neutral must be grounded and connected to the ACOPOS protective ground conductor. In this way, it is possible to prevent overvoltages between external conductors and the ACOPOS housing. Three-phase isolation transformers with the corresponding input and output voltages and a vector group with secondary neutral can be used (e.g. 3 x 400 V / 3 x 400 V, Dyn3).

Danger!

The ACOPOS servo drives are only allowed to be operated directly on grounded, three-phase industrial mains (TN, TT systems). When using the servo drives in living areas, shops and small businesses, additional filtering measures must be implemented by the user.

1.1.2 Supply Voltage Range

The permissible supply voltage range for ACOPOS servo drives is 3 x 400 VAC to 3 x 480 VAC $\pm 10\%$. Respective intermediate transformers must be used for other supply voltages. With grounded power mains, autotransformers can also be used to adjust the voltage. Neutral does not have to be connected for this type of transformer.

1.1.3 Protective Ground Connection (PE)

The following information concerning the protective ground connection corresponds to IEC 61800-5 (draft), Item 3.2.5.3 "Connection elements for the protective ground conductor" and must be followed.

Wire Cross Section

The wire cross section for the protective ground conductor is oriented to the external conductors and must be selected according to the following table:

Wire Cross Section for External Line A [mm ²]	Minimum Wire Cross Section for Protective Ground Connection A _{PE} [mm ²]
A ≤ 16	A
16 < A ≤ 35	16
35 < A	A / 2

Table 48: Selection of the protective ground conductor cross section

Increased Discharge Current

ACOPOS servo drives are devices with increased discharge current (larger than 3.5 mA AC or 10 mA DC). Therefore a fixed (immobile) protective ground connection is required on the servo drives.

The following conditions must be met, depending on the ACOPOS device being used:

ACOPOS	Conditions	Image
1022 1045 1090	In addition to the connection of the first protective ground conductor on terminal X3 / PE, a second protective ground conductor with the same cross section must be connected on the designated terminal (threaded bolt M5).	

Table 49: Protective ground conditions according to ACOPOS device

ACOPOS	Conditions	Image
1180 1320	In addition to the connection of the first protective ground conductor on terminal X3 / PE, a second protective ground conductor with the same cross section must be connected on the designated terminal (threaded bolt M5).	
1640 128M	The cross section of the protective ground conductor connected to terminal X3 / PE must be at least 10 mm² Cu.	

Table 49: Protective ground conditions according to ACOPOS device (cont.)

1.2 Dimensioning

In general, dimensioning the power mains, the overcurrent protection and the line contactors depend on the structure of the power mains connection. The ACOPOS servo drives can be connected individually (each drive has separate overcurrent protection and, if necessary, a separate line contactor) or together in groups.

1.2.1 Individual ACOPOS Power Mains Connections

The structure of an individual power mains connection with line contactor and circuit breaker can be seen in the following diagram:

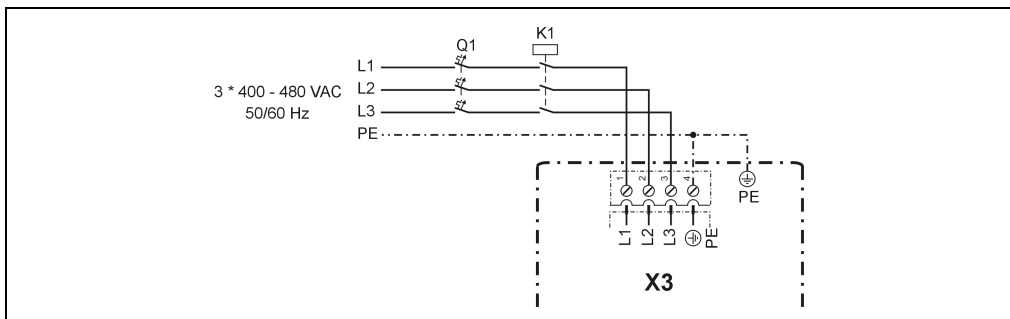


Figure 21: Circuit diagram for ACOPOS X3, individual power mains connection

Dimensioning the Power Mains and Overcurrent Protection

The cross section of the power mains and the rated current for overcurrent protection should be dimensioned for the average current load to be expected.

The power mains are to be equipped with overcurrent protection in the form of a circuit breaker or a fuse. Circuit breakers (time lag) with type C tripping characteristics (according to IEC 60898) or fuses (time lag) with type gM tripping characteristics (according to IEC 60269-1) are to be used.¹⁾

The average current load to be expected can be calculated as follows:

$$I_{\text{mains}}[\text{A}] = \frac{S[\text{VA}]}{\sqrt{3} \cdot U_{\text{mains}}[\text{V}]}$$

The apparent power S can be calculated as follows:²⁾

$$S[\text{VA}] = M_{\text{eff}}[\text{Nm}] \cdot k \cdot \frac{2 \cdot \pi \cdot n_{\text{aver}}[\text{min}^{-1}]}{60}$$

The constant k for each of the various ACOPOS servo drives can be taken from the following table:

Description	ACOPOS						
	1022	1045	1090	1180	1320	1640	128M
Constant k	2.8	2.4		2.1	1.9	1.7	1.5

Table 50: Constant k

- 1) Circuit breakers are available on the market with rated currents from 6 A to 63 A. Outside of this range, fuses must be used.
- 2) If information concerning load torque, inertia and friction are available, the effective torque is calculated using the following formula (the nominal torque of the motor can also be used here if the motor is dimensioned correctly):

$$M_{\text{eff}}[\text{Nm}] = \sqrt{\frac{1}{T_{\text{cycle}}[\text{s}]} \cdot \sum_i M_i[\text{Nm}]^2 \cdot t_i[\text{s}]}$$

To calculate n_{ave} , information concerning the positioning cycle must be available.

n_{ave} is calculated using the following formula:

$$n_{\text{aver}}[\text{min}^{-1}] = \frac{1}{T_{\text{cycle}}[\text{s}]} \cdot \sum_i n_i[\text{min}^{-1}] \cdot t_i[\text{s}]$$

The cross section of the power mains and the rated current of the overcurrent protection used are chosen according to table 51 "Maximum current load for PVC insulated three-phase cables or individual wires", on page 101 so that the maximum current load for the cable cross section selected is greater than or equal to the calculated mains current.

$$I_Z \geq I_{\text{mains}}$$

The rated current of the overcurrent protection must be less than or equal to the maximum current load for the cable cross section selected (see table 51 "Maximum current load for PVC insulated three-phase cables or individual wires", on page 101).

$$I_B \leq I_Z$$

The following table shows the maximum current load of PVC insulated three-phase cables (or three current-carrying wires) according to IEC 60204-1 at 40 °C environmental temperature ¹⁾ and 70 °C maximum conductor temperature (maximum current load for installation type F and cross sections greater than 35 mm², IEC 60364-5-523 is used for installation types B1 and B2).

Line cross section [mm ²]	Maximum current load for the cable cross section I_Z / rated current for the overcurrent protection I_R [A] depending on the type of installation				
	Three individual wires in insulating conduit or cable duct	Three-phase cable in insulating conduit or cable duct	Three-phase cable on walls	Three-phase cable in a cable tray	Three individual wires in a cable tray
	B1	B2	C	E	F
1.5	13.5 / 13	12.2 / 10	15.2 / 13	16.1 / 16	---
2.5	18.3 / 16	16.5 / 16	21 / 20	22 / 20	---
4	25 / 25	23 / 16	28 / 25	30 / 25	---
6	32 / 32	29 / 25	36 / 32	37 / 32	---
10	44 / 32	40 / 32	50 / 50	52 / 50	---
16	60 / 50	53 / 63	66 / 63	70 / 63	---
25	77 / 63	67 / 63	84 / 80	88 / 80	96 / 80
35	97 / 80	83 / 80	104 / 100	114 / 100	119 / 100
50	117 / 100	103 / 100	123 / 100	123 / 100	145 / 125
70	149 / 125	130 / 125	155 / 125	155 / 125	188 / 160
95	180 / 160	156 / 125	192 / 160	192 / 160	230 / 200

Table 51: Maximum current load for PVC insulated three-phase cables or individual wires

When determining the cross section for the power mains, make sure that the cross section selected is within the range that can be used with power mains terminal X3 (see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138).

1) The maximum current load value in IEC 60204-1 is for an environmental temperature of 40 °C. In IEC 60364-5-523, this reference temperature is 30 °C. The values in table 51 "Maximum current load for PVC insulated three-phase cables or individual wires", on page 101 from IEC 60364-5-523 are calculated with the factor $k_{\text{Temp}} = 0.87$ given in the standard and also at 40 °C.

Dimensioning the Line Contactor

The rated current of the line contactor is oriented to the overcurrent protection for the power mains connection. The line contactor is set up so that nominal operating current specified by the manufacturer of the line contactor for category AC-1 is approximately 1.3 times the rated current of the overcurrent protection.

1.2.2 Implementing ACOPOS Power Mains Connections for Drive Groups

The structure of the power mains connection for a drive group with line contactor and circuit breaker can be seen in the following diagram:

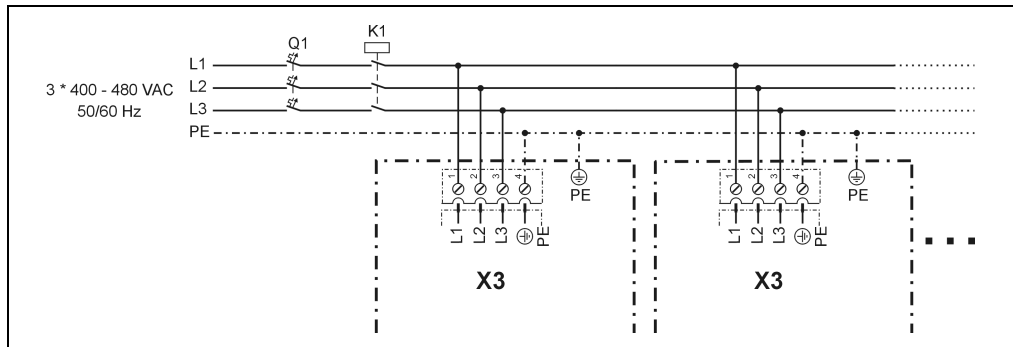


Figure 22: Circuit diagram for ACOPOS X3, power mains connection for a drive group

Dimensioning the Power Mains and Overcurrent Protection

The cross section of the distribution point and all power mains connections are chosen according to table 51 "Maximum current load for PVC insulated three-phase cables or individual wires", on page 101 so that the maximum current load for the cable cross section selected ¹⁾ is greater than or equal to the sum of the calculated mains current.

$$I_Z \geq \sum I_{\text{mains}}$$

The rated current of the overcurrent protection must be less than or equal to the maximum current load for the cable cross section selected (see table 51 "Maximum current load for PVC insulated three-phase cables or individual wires", on page 101).

$$I_B \leq I_Z$$

1) When determining a common cross section for several drives (especially with different sized ACOPOS modules), make sure that the cross section selected is within the range that can be used with the power mains terminals (see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138).

Dimensioning the Line Contactor

The rated current of a common line contactor is oriented to the overcurrent protection for the power mains connection. The line contactor is set up so that nominal operating current specified by the manufacturer of the line contactor for category AC-1 is approximately 1.3 times the rated current of the overcurrent protection.

1.3 Fault Current Protection

Fault current protection (RCD - residual current-operated protective device) can be used with ACOPOS servo drives. However the following points must be noted:

ACOPOS servo drives have a power rectifier. If a short-circuit to the frame occurs, a flat DC fault current can be created which prevents an AC current or pulse current sensitive RCD (Type A or AC) from being activated, therefore canceling the protective function for all connected devices.

Danger!

If used for protection during direct or indirect contact of the fault current protection (RCD), only a Type B RCD (AC-DC sensitive, according to IEC 60755) can be used for the ACOPOS power mains connection. Otherwise additional protective measures must be used, such as neutralization or isolation from the power mains using an isolation transformer.

1.3.1 Rated Fault Current

On ACOPOS servo drives, fault current protection with a rated fault current ¹⁾ of ≥ 100 mA can be used. However, errors can occur:

- When connecting servo drives to the power mains (short-term single-phase or two-phase operation because of contact chatter on the line contactor).
- Because of high frequency discharge currents occurring during operation when using long motor cables.
- Because of an extreme unbalance factor for the three-phase system.

¹⁾ The rated fault current listed by the manufacturer are maximum values which will definitely trip the protective device. Normally, the protective device is tripped at approximately 60 % of the rated fault current.

1.3.2 Estimating the Discharge Current

Depending on the connection of the ACOPOS servo drive, different discharge currents flow to ground on the protective ground conductor (PE):

Single-phase or two-phase operation (as intermediate state when switching on the line contactor):

$$I_A[A] = \frac{U_{\text{mains}}[V] \cdot 2 \cdot \pi \cdot f_{\text{mains}}[\text{Hz}] \cdot C_A[F]}{\sqrt{3}}$$

Single-phase operation with neutral (lab or test operation):

$$I_A[A] = \frac{U_{\text{mains}}[V] \cdot 2 \cdot \pi \cdot f_{\text{mains}}[\text{Hz}] \cdot C_A[F]}{2 \cdot \sqrt{3}}$$

The discharge capacitance C_D the various ACOPOS servo drives can be taken from the following table:

Description	ACOPOS						
	1022	1045	1090	1180	1320	1640	128M
Discharge capacitance C_D	660 nF			3.1 μ F		... ¹⁾	

Table 52: Discharge capacitance C_D

1) Integrated line filter in preparation.

1.3.3 Manufacturer Used

For example, the AC-DC sensitive, 4 pole fault current protective device F 804 from ABB (fault current: 300 mA; nominal current: 63 A) can be used. Using this fault current protective device, approximately 5 ACOPOS 1022 (or 1045, 1090) can be connected in parallel.

2. DC Bus

2.1 General Information

With ACOPOS servo drives, it is possible to connect several servo drives via the DC bus. This connection allows compensation of braking and drive energy of several axes or the distribution of braking energy to several braking resistors.

The connection is made using terminals X2 / +DC and -DC. The structure of the DC bus connections can be seen in the following diagram:

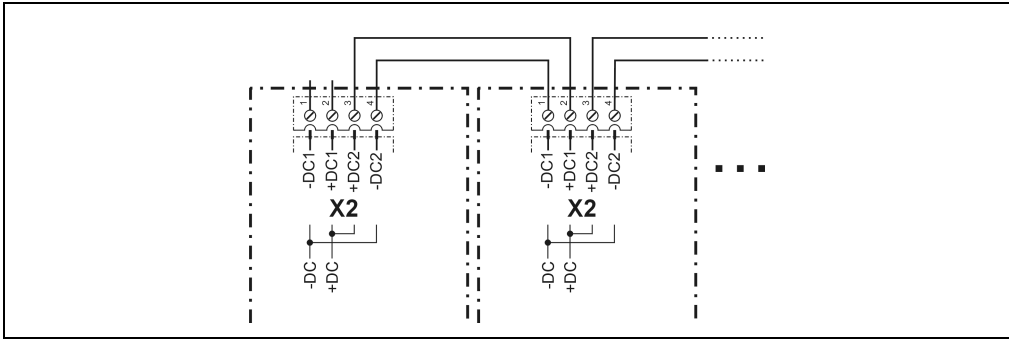


Figure 23: ACOPOS X2 circuit diagram, DC bus connections

Caution!

To prevent excessively high discharge currents from flowing over the individual servo drives, make sure that smaller servo drives are not connected between two larger servo drives.

2.2 Wiring

The DC bus connections on the ACOPOS servo drives do **not** have short circuit and ground fault protection and are not protected against reverse polarity. Therefore the DC bus connections must be wired correctly.

Caution!

The DC bus connections must be wired correctly (no short circuits, ground faults or reverse polarity).

A suitable measure to ensure that the wiring is secure against short circuits and ground faults ¹⁾ is the use of corresponding cabling. Special rubber-insulated wires with increased resistance to heat (90 °C) of types

- NSGAÖU
- NSGAFÖU
- NSGAFCMÖU

with a nominal voltage U_0/U of at least 1.7/3 kV are considered to be secure against short circuits and ground faults in switchgear and distribution systems up to 1000 V ²⁾.

1) Cabling e.g. according to DIN VDE 0100, part 200 "Electrical systems for buildings - terms", item A.7.6.

2) See e.g. DIN VDE 0298, part 3 "Use of cables and insulated wires for high-voltage systems", item 9.2.8.

2.3 Equal Distribution of the Applied Power via the Power Rectifiers

When creating a DC bus connection between several servo drives, it is possible that the parallel connection of the power rectifiers causes incorrect distribution of the applied power. To prevent this undesired effect, appropriately dimensioned shunt resistors are integrated in the ACOPOS servo drives.

The following rules must be observed so that the effect of these shunt resistors is not cancelled out:

- The length of the DC bus wiring is not allowed to exceed a total length of 3 m and must be within a single switching cabinet.
- Dimensioning the cross section of the ACOPOS servo drive power mains must be done according to section "Dimensioning the Power Mains and Overcurrent Protection" on page 100.
- The cross section of the DC bus wiring ¹⁾ on the respective ACOPOS servo drives must be less than or equal to the cross section of the servo drive power mains.
- The selected cross section must be within the range possible for the DC bus connection terminal X2 (see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138).

2.4 Equal Distribution of the Brake Power on the Braking Resistors

The braking resistors integrated in the ACOPOS servo drives as well as braking resistors which can be connected externally are controlled using a specially developed procedure. This guarantees that the brake power is optimally and equally distributed on the braking resistors when a DC bus connection is made between several units.

When using the integrated braking resistors, additional configuration is not required.

When using external braking resistors, the corresponding parameters must be defined (see section 4.4 "Setting Brake Resistor Parameters", on page 115).

1) The cross section of the individual segments of the DC bus wiring must be dimensioned for the thermal equivalent effective value of the respective compensation current. If information concerning the flow of the compensation current is available, calculate the thermal equivalent effective value of the compensation current using

$$I_q[A] = \sqrt{\frac{1}{T_{\text{cycle}}[s]} \cdot \sum_i I_i[A]^2 \cdot t_i[s]}$$

The cross section of the DC bus connection should then also be selected as described in table 60 "Terminal cross sections for ACOPOS servo drives", on page 138, so that the maximum current load of the cable cross section is greater than or equal to the thermal equivalent effective value of the compensation current ($I_L \geq I_q$).

2.5 Connection of External DC Bus Power Supplies

The ACOPOS servo drives recognize a power failure and can immediately initiate active braking of the motor. The brake energy that occurs when braking is returned to the DC bus and the DC bus power supply can use it to create the 24 VDC supply voltage. In this way, the ACOPOS servo drives as well as encoders, sensors and possible safety circuit can be supplied with 24 VDC while braking. ¹⁾

An external DC bus power supply must be used for ACOPOS servo drives 8V1022 to 8V1090. A DC bus power supply is integrated in ACOPOS servo drives 8V1180 to 8V128M.

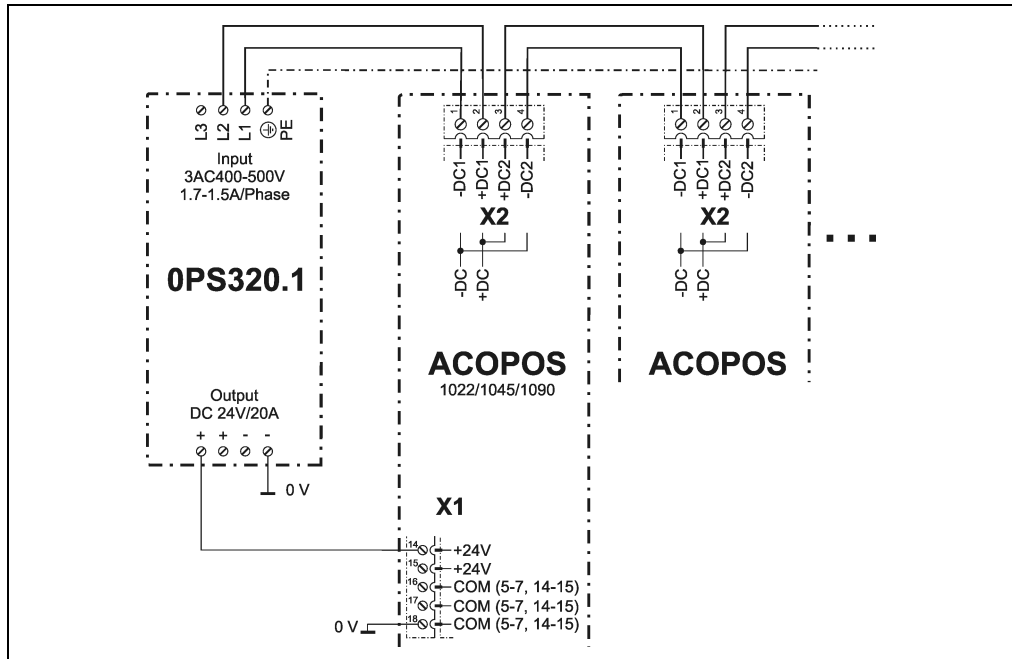


Figure 24: B&R power supply 0PS320.1 as DC bus power supply for ACOPOS servo drives

1) WARNING: In some applications, there is not enough brake energy provided to guarantee that the 24 VDC supply voltage remains active until the system is stopped.

3. Motor Connection

On B&R motors, the power connections, the connections for the holding brake and the connections for the motor temperature sensor are all made using the same motor plug. On the servo drive, the motor connection is made using terminals X5 / U, V, W and PE as well as terminals X4b / B+, B-, T+ and T-. The motor connection must be shielded correctly (see section 1.1 "Electromagnetic Compatibility of the Installation", on page 121).

The structure of the motor connection can be seen in the following diagram:

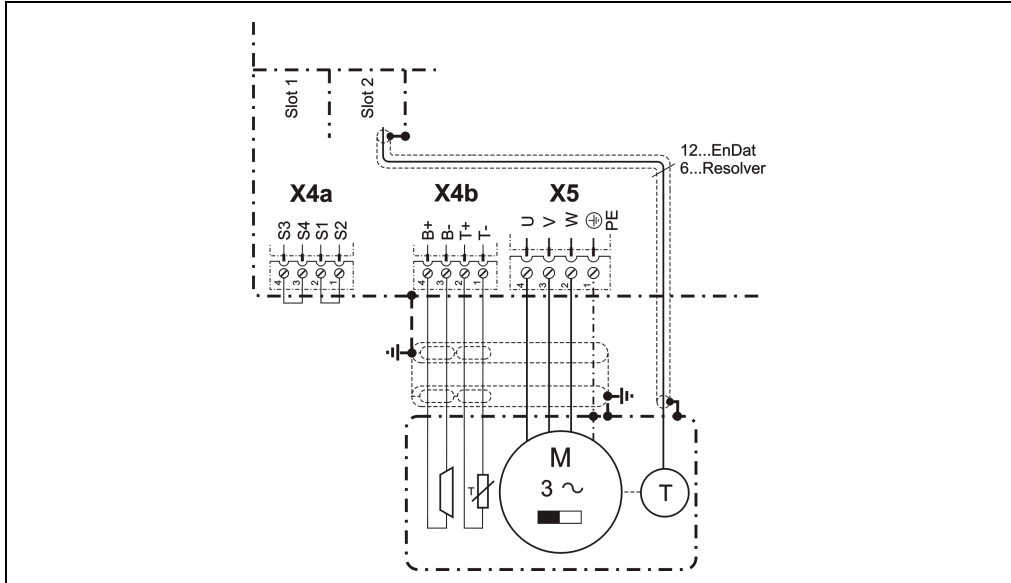


Figure 25: ACOPOS X4/X5 circuit diagram, motor connection

The cross section of the motor cable must be dimensioned for the thermal equivalent effective value of the motor current. ¹⁾

The cross section of the motor cable is chosen for B&R motor cables according to the following table so that the maximum current load for the cable cross section selected is greater than or equal to the thermal equivalent effective value of the motor current:

$$I_z \geq I_q$$

1) If information concerning load torque, inertia and friction are available, the thermal equivalent effective value for the motor current of the motor used is calculated as follows:

$$I_q[A] = \sqrt{\frac{1}{T_{\text{cycle}}[s]} \cdot \sum_i I_i[A]^2 \cdot t_i[s]}$$

The following table shows the maximum current load for special insulated three-phase cables according to IEC 60364-5-523 at 40 °C environmental temperature ¹⁾ and 90 °C maximum cable temperature.

Line cross section [mm ²]	Maximum current load on the line I_Z [A] depending on type of installation		
	Three-phase cable in insulating conduit or cable duct	Three-phase cable on walls	Three-phase cable in a cable tray
	B2	C	E
1.5	17.8	20	20.9
4	31.9	36.4	38.2
10	54.6	64.6	68.3
35	116.5	133.8	143.8

Table 53: Maximum current load for special insulated three-phase cables

When determining the cross section for the motor cable, make sure that the cross section selected is within the range that can be used with motor connection terminal X5 (see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138).

1) The entry for the maximum current load in IEC 60364-5-523 is for an environmental temperature of 30 °C. The values in table 53 "Maximum current load for special insulated three-phase cables", on page 110 are calculated with the factor $k_{Temp} = 0.91$ given in the standard for use at 40 °C environmental temperature.

4. Braking Resistor

4.1 General Information

When braking servo motors, power is returned to the servo drive. This causes the capacitors in the DC bus to be charged to higher voltages. Starting with a DC bus voltage of approx. 800 V, the ACOPOS servo drive links the braking resistor to the DC bus using the brake chopper and converts the braking energy to heat.

For ACOPOS servo drives, braking resistors are integrated for this purpose or external braking resistors can be connected. The equipment differences can be found in the following table:

Description	ACOPOS						
	1022	1045	1090	1180	1320	1640	128M
DC Bus Capacitor	235 µF		470 µF	940 µF	1645 µF	3300 µF	6600 µF
Integrated Brake Chopper	Yes						
Internal Braking Resistor	Yes	Yes		Yes		Yes ¹⁾	Yes ¹⁾
Continuous Power Output	130 W	200 W		400 W		200 W	240 W
Maximum Power	3.5 kW	7 kW		14 kW		7 kW	8.5 kW
Connection of External Braking Resistor Possible ²⁾	No ⁴⁾			Yes	Yes		
Continuous Power Output	---			8 kW	24 kW		
Maximum Power	---			40 kW	250 kW		
Minimum braking resistance (R_{Bmin})	---			15 Ω	2.5 Ω		
Rated current for the built-in fuse (I_B) ³⁾	---			10 A (fast-acting)	30 A (fast-acting)		

Table 54: Braking resistors for ACOPOS servo drives

- 1) The braking resistor integrated in the ACOPOS servo drives 1640 and 128M is dimensioned so that it is possible to brake to a stop (in a typical drive situation).
- 2) The ACOPOS servo drives are designed so that either the integrated braking resistor or the external braking resistor can be activated. Braking with both braking resistors at the same time is not possible.

Switching takes place using the software and is only possible during the ACOPOS servo drive initialization phase:

ParID 398: Setting for an internal / external braking resistor

0 ... Internal (default)

1 ... External

- 3) The fuses used must be fast-acting fuses Ø10 x 38 mm for 600 VAC/VDC.
For example, type KLKD0xx (xx is the rated current of the fuse in amperes e.g. KLKD030) from Littelfuse (www.littelfuse.com) can be used.
- 4) The braking resistors integrated in ACOPOS servo drives 1022, 1045 and 1090 are optimally dimensioned for the respective sizes.

4.2 External Braking Resistor Connection

The external braking resistors are connected using terminals X6 / RB+, RB- and PE. The structure of the external braking resistor connection can be seen in the following diagram:

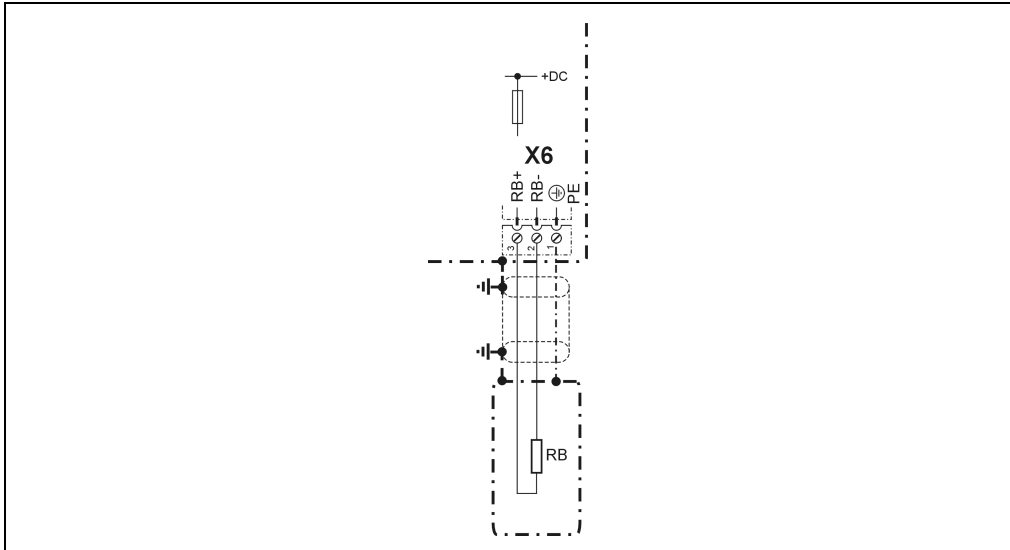


Figure 26: Circuit diagram for ACOPOS X6, external braking resistor on ACOPOS 1180/1320/1640/128M

When determining the cross section ¹⁾ for wiring the external braking resistor, make sure that the cross section selected is within the range that can be used with braking resistor connection terminal X6 (see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138).

- 1) The cross section of the braking resistor cable must be dimensioned for the thermal equivalent effective value of the respective brake current. If information concerning the flow of the brake current is available, calculate the thermal equivalent effective value of the brake current using

$$I_q[A] = \sqrt{\frac{1}{T_{cycle}[s]} \cdot \sum_i I_i[A]^2 \cdot t_i[s]}$$

The cross section of the braking resistor connection should then be selected as described in table 51 "Maximum current load for PVC insulated three-phase cables or individual wires", on page 101, so that the maximum current load of the cable cross section is greater than or equal to the thermal equivalent effective value of the brake current ($I_L \geq I_q$).

4.3 Dimensioning the Braking Resistor

Like other drive components, the externally connected braking resistors must be dimensioned according to the requirements of the application.

To determine the required braking power ($P_{Br_{max}}$ and $P_{Br_{ave}}$), the mechanical values $M(t)$, $\omega(t)$ and T_{cycle} must be known. The following formulas are used to determine the drive power curve:

$$P(t)[W] = M(t)[Nm] \cdot \omega(t)[rad \cdot s^{-1}]$$

$$\omega(t)[rad \cdot s^{-1}] = 2 \cdot \pi \cdot \frac{n(t)[min^{-1}]}{60[s \cdot min^{-1}]}$$

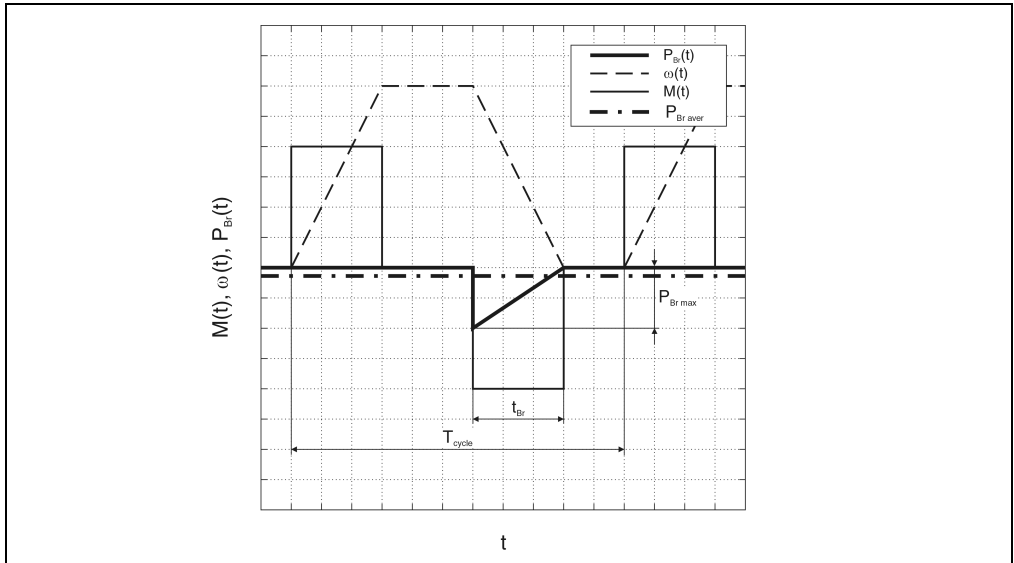


Figure 27: Diagram of a typical movement with the brake power curve $P_{Br}(t)$ ¹⁾

- 1) If - as shown - a typical triangular brake power curve occurs, then the average brake power can be calculated directly with the following formula:

$$P_{Br_{aver}}[W] = \frac{1}{T_{cycle}[s]} \cdot \frac{P_{Br_{max}} \cdot t_{Br}}{2}$$

The calculation is continued by deriving the brake power curve $P_{Br}(t)$ from the drive power curve. The power must be set to zero in areas where it is positive ($P(t) > 0$). This results in the following maximum brake power

$$P_{Br_{max}}[W] = \text{abs}(\max(P_{Br}(t)[W]))$$

Then the average brake power is calculated over the given cycle

$$P_{Br_{aver}}[W] = \frac{1}{T_{cycle}[s]} \cdot \sum_i P_{Br_i}(t)[W] \cdot t_i[s]$$

In order to use an external braking resistor ¹⁾, the following parameters must be calculated:

- the resistance (R_{Br})
- the maximum power ($P_{Br_{max}}$)
- the nominal power (P_{BrN})

4.3.1 Resistance of the External Braking Resistor

The resistance of the external braking resistor R_{Br} can be calculated as follows:

$$R_{Br}[\Omega] = \frac{U_{DC}[V]^2}{P_{Br_{max}}[W]} = \frac{800[V]^2}{P_{Br_{max}}[W]}$$

The selected resistance is not allowed to be less than the **minimum** resistance for the respective ACOPOS servo drive (see table 54 "Braking resistors for ACOPOS servo drives", on page 111).

$$R_{Br}[\Omega] \geq R_{Br_{min}}[\Omega]$$

If this condition is not met, the maximum brake power required cannot be reached! Typical resistances are between 4 and 50 Ω depending on the size of the ACOPOS device.

Caution!

If a resistance less than the minimum resistance is used, the brake chopper built into the ACOPOS device could be destroyed!

Then the following calculation

$$P_{Br_{aver}}[W] \leq R_{Br}[\Omega] \cdot I_B[A]^2$$

must be made to check if the average continuous power for the brake can be reached with the selected braking resistor on the ACOPOS servo drive. The brake power which can be continually output by the ACOPOS device is limited by the built-in fuse (rated current of the built-in fuse, see table 54 "Braking resistors for ACOPOS servo drives", on page 111).

¹⁾ Reliable braking resistors are available from Danotherm (www.danotherm.com).

4.3.2 Power Data for the External Braking Resistor

The maximum power that the external braking resistor must be able to dissipate is calculated as follows:

$$P_{R_{Br_{max}}} [W] \geq P_{Br_{max}} [W]$$

The nominal power (the power which can be continually dissipated) for the external braking resistor is calculated using the following formulas:

$$P_{R_{Br_N}} [W] \geq P_{Br_{aver}}$$

$$P_{R_{Br_N}} [W] \geq \frac{1}{30} \cdot P_{R_{Br_{max}}} [W]$$

The second condition depends on ACOPOS internal relationships.

4.3.3 Nominal Voltage of the External Braking Resistor

The external braking resistor must be selected so that it can handle the maximum voltage that can occur during operation.

During braking, voltages up to 900 VDC can occur.

Danger!

During braking, voltages up to 900 VDC can occur on the external braking resistor. The external braking resistor must be able to handle these voltages.

4.4 Setting Brake Resistor Parameters

The braking resistors integrated in the ACOPOS servo drives as well as braking resistors which can be connected externally are controlled using a specially developed procedure. This guarantees that the brake power is optimally and equally distributed on the braking resistors when a DC bus connection is made between several units.

4.4.1 Using the Integrated Braking Resistors

No settings or configuration is required by the user.

4.4.2 Using External Braking Resistors

When using external braking resistors, the following parameters must be set on the ACOPOS servo drive using B&R Automation Studio™:

ParID	Formula Symbols	Description	Unit
10	R_{Br}	Ohmic resistance	[Ω]
11	$T_{Br_{max}}$	Maximum over-temperature on the external braking resistor	[°C]
12	$R_{Br_{Th}}$	Thermal resistance between braking resistor and the environment ¹⁾	[°C/W]
13	$C_{Br_{Th}}$	Heat capacitance of the filament ²⁾	[Ws/°C]

Table 55: ParIDs for setting external braking resistor parameters

- 1) Total thermal resistance for series or parallel connections of several (n_{Br}) of the **same** braking resistors:

$$R_{Br_{Th_{total}}} = \frac{R_{Br_{Th}}}{n_{Br}}$$

- 2) Total heat capacitance of the filament for series or parallel connections of several (n_{Br}) of the **same** braking resistors:

$$C_{Br_{Th_{total}}} = C_{Br_{Th}} \cdot n_{Br}$$

The parameters can normally be found on the data sheet from the manufacturer. ¹⁾

The parameters are based on the following thermal equivalent circuit for the external braking resistor:

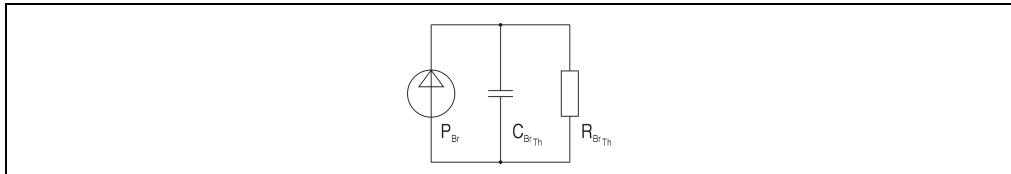


Figure 28: Thermal equivalent circuit for the external braking resistor

If a value for the maximum over-temperature of the external braking resistor is not given, it can be determined using the following formula:

$$T_{Br_{max}} = P_{R_{Br_N}} \cdot R_{Br_{Th}}$$

1) An example of reliable braking resistors are Σ SIGMA type braking resistors from Danotherm (www.danotherm.com).

5. Configuration of ACOPOS Servo Drives

The plug-in modules for ACOPOS servo drives allow each servo drive to be individually configured according to the requirements of the application. When putting together plug-in module combinations, the power consumption must be checked. This then results in the current requirements of the ACOPOS servo drive configuration.

5.1 Maximum Power Output via the Four ACOPOS Servo Drive Slots

The maximum power output for all four slots is 22 W. The total power consumption for all plug-in modules must be less than or equal to the maximum power output.

$$P_{\max} = 22\text{ W} \geq \sum P_{\text{module}}[\text{W}]$$

The power consumption of the individual modules can be found in table 56 "Power consumption of the ACOPOS plug-in modules" or the technical data for the modules (see chapter 2 "Technical Data"):

Plug-in module	Power Consumption
8AC110.60-2	Max. 0.7 W
8AC112.60-1	Max. 2.5 W
8AC120.60-1	Depends on the EnDat encoder connected
E0 ... EnDat single-turn, 512 lines	Max. 1.8 W
E1 ... EnDat multi-turn, 512 lines	Max. 2.5 W
E2 ... EnDat single-turn, 32 lines (inductive)	Max. 2.2 W
E3 ... EnDat multi-turn, 32 lines (inductive)	Max. 1.9 W
E4 ... EnDat single-turn, 512 lines	Max. 1.7 W
E5 ... EnDat multi-turn, 512 lines	Max. 2.2 W
8AC122.60-2	Max. 1.2 W
8AC123.60-1	Max. 7.5 W Depends on the current requirements for the encoder connected ¹⁾
8AC130.60-1	Max. 0.8 W
8AC131.60-1	Max. 1 W

Table 56: Power consumption of the ACOPOS plug-in modules

- 1) The power consumption of the plug-in module can be approximated using the following formula:

$$P_{\text{Module}}[\text{W}] = P_{\text{Encoder}}[\text{W}] \cdot k + 0.6\text{ W}$$

The power consumed by the encoder P_{Encoder} is calculated from the selected encoder supply voltage (5 V / 15 V) and the current required:

$$P_{\text{Encoder}}[\text{W}] = U_{\text{Encoder}}[\text{V}] \cdot I_{\text{Encoder}}[\text{A}]$$

The following values must be used for k:

- k = 1.2 (with 15 V encoder supply)
- k = 1.75 (with 5 V encoder supply)

5.2 24 VDC Current Requirements for the ACOPOS Servo Drive

The 24 VDC current requirements has to be regarded differently depending on the size of the ACOPOS servo drive.

- The following estimation can always be used for the ACOPOS 1022, 1045 and 1090:

$$I_{24VDC}[A] = I_{24VDC_{max}}[A] - \frac{1,1}{24V \cdot k} \cdot (22W - \sum P_{module}[W])$$

- This estimation can also be used for the ACOPOS 1180, 1320, 1640 and 128M as long as a mains input voltage is not applied. As soon as a mains input voltage is applied to these servo drives, the 24 VDC supply voltage is created via the integrated DC bus power supply; the 24 VDC current requirements (I_{24VDC}) is then reduced to 0.

The 24 VDC maximum current requirements for the ACOPOS servo drives can be found in table 57 "Maximum current requirements and constant k" or the technical data for the ACOPOS servo drives (see chapter 2 "Technical Data").

Description	ACOPOS						
	1022	1045	1090	1180	1320	1640	128M
$I_{24VDC_{max}}$	2.5			2.8		--- ¹⁾	
k	0.64			0.63		--- ¹⁾	

Table 57: Maximum current requirements and constant k

¹⁾ In preparation.

6. Formula Variables Used

Symbol	Unit	Description
C_D	F	Discharge capacitance
C_{BrTh}	Ws/°C	Heat capacitance of the filament
k	---	General constants
f_{mains}	Hz	Mains frequency
I_{24VDC}	A	24 VDC current requirements
$I_{24VDC_{max}}$	A	24 VDC maximum current requirements
I_A	A	Discharge current via protective ground conductor (PE)
I_B	A	Rated current for overcurrent protection
I_{mains}	A	Mains current (phase current)
I_q	A	Thermal equivalent current effective value
I_Z	A	Maximum current load on a cable
M	Nm	Torque (general)
M_{eff}	Nm	Effective load torque for a cycle
n	min ⁻¹	Speed (general)
n_{aver}	min ⁻¹	Average speed for a cycle
ω	rad/s	Rotational Speed
P	W	Power or true power (general)
P_{Br}	W	Brake power
$P_{Br_{max}}$	W	Maximum brake power
$P_{Br_{aver}}$	W	Average brake power
$P_{R_{Br_{max}}}$	W	Maximum load on the external braking resistor
$P_{R_{BrN}}$	W	Nominal power of the external braking resistor
P_{max}	W	Maximum power
P_{module}	W	Power consumption of the plug-in modules
p	---	Pi (3.1415)
R_{Br}	W	Braking resistor
$R_{Br_{min}}$	W	Minimum braking resistance
R_{BrTh}	°C/W	Thermal resistance between braking resistor and the environment
S	VA	Apparent power
t	s	Time (general)
t_{Br}	s	Braking time
$T_{Br_{max}}$	°C	Maximum over-temperature of the resistor
T_{cycle}	s	Cycle time
U_{DC}	V	DC bus voltage
U_{mains}	V	Supply voltage (phase to phase)

Table 58: Formula variables used

Chapter 5 • Wiring

1. General Information

1.1 Electromagnetic Compatibility of the Installation

1.1.1 General Information

If the guidelines for electromagnetic compatibility of the installation are followed, ACOPOS servo drives meet EMC guidelines 89/336/EEG and low-voltage guidelines 73/23/EEG. They meet the requirements for harmonized EMC product standard IEC 61800-3:1996 + A11:2000 for industry (second environment).

Additional EMC measures must be implemented by the manufacturer of machines or systems if the product standards for the machine has lower limits or if the machine should conform to generic standard IEC 61000-6-4. Additional EMC measures may also be needed for machines with a large number of ACOPOS servo drives. The installation of a central line filter is mostly sufficient in such cases. Proof of conformity to the necessary limits must be provided according to the documentation for use of the EMC guidelines from the manufacturer or distributor of the machine or system.

Additional EMC measures are needed when operating ACOPOS servo drives in living area or when connecting ACOPOS servo drives to a low voltage system which supplies buildings in living areas without an intermediate transformer (first environment).

1.1.2 Installation Notes

- 1) The switching cabinet or the system must be constructed appropriately.
- 2) To prevent the effects of disturbances, the following lines must be properly shielded:
 - motor lines
 - encoder cables
 - control lines
 - data cables
- 3) Inductive switching elements such as contactors or relays are to be equipped with corresponding suppressor elements such as varistors, RC elements or damping diodes.
- 4) All electrical connections are to be kept as short as possible.
- 5) Cable shields are to be attached to the designated shield terminals and the plug housing.
- 6) Shielded cables with copper mesh or tinned copper mesh are to be used. Twisting or extending the protective mesh using single conductors is not allowed.
- 7) Unused cable conductors are to be grounded on both sides if possible.

3 * 400 - 480 VAC
50/60 Hz

L1
L2
L3
PE

Q1

X2 X3

+24 V
0 V
+24 V
+24 V
0 V
+24 V
0 V

Trigger1
Quickstop/Trigger2
COM (1, 2)
Shield
End+
End-
Ref
Enable
Enable
COM (8, 9)
COM (8, 9)
n.c.
+24V out / 0.5A
+24V
+24V
COM (5-7, 13-15)
COM (5-7, 13-15)
COM (5-7, 13-15)

X1

ACOPOS

Slot 1 Slot 2 Slot 3 Slot 4

CAN, ETHERNET Powerlink

12...EnDat
6...Resolver

X4a X4b X5 X6

S3 S4 S1 S2
B+ B- T+ T-
U V W PE
RB+ RB- PE

M
3 ~
T
RB

ACOPOS User's Manual

- ❶ The protective ground conductors (PE) for the power mains, the motor lines and external braking resistor connection are internally connected with the housing of the ACOPOS servo drive.
- ❷ The second protective ground conductor connection is required because of the increased discharge current ($> 3.5 \text{ mA}$) on ACOPOS servo drives 1022, 1045, 1090, 1180 and 1320. The same cross section as the power mains protective ground conductor must be used.
- ❸ Both trigger inputs are only filtered internally with approx. $50 \mu\text{s}$. Make sure the cable shield is grounded properly.
- ❹ The cable shield must be attached to the shield connector.
- ❺ On all plug-in modules, the two screws used to fasten the module must be tightened so that the mounting bracket is connected to ground.
- ❻ Using a DSUB connector:

The cable shield must be connected to the designated clamp in the metallic or metal plated plug housing. The fastening screws must be tightened.

Cable connection via terminals:

The cable shield must be attached to the shield connection terminal.

Cable connection via RJ45 plug:

Also grounding the cable shield provides an improvement in EMC properties. Grounding should take place on both sides, extensively and near to the connector.

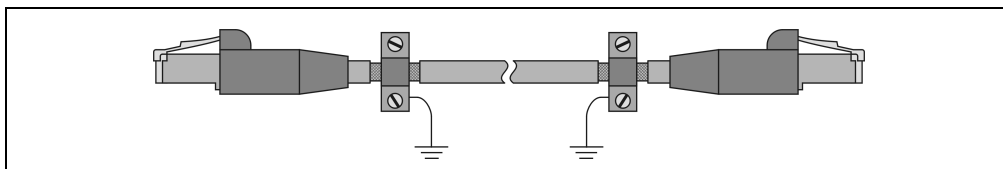


Figure 30: Cable shield grounding for the ETHERNET Powerlink cable

- ⑦ The cable shield for the motor line or the connection cable for the external braking resistor is connected with the housing of the ACOPOS servo drive via the grounding plate using the grounding clamp provided:

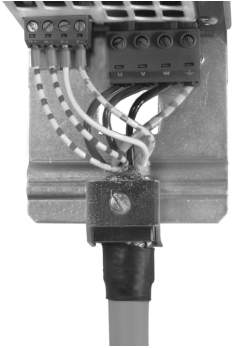
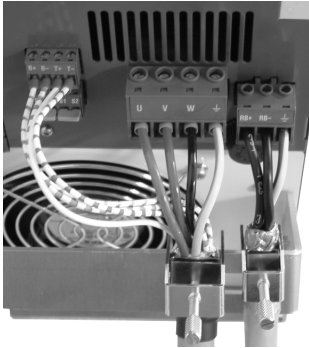
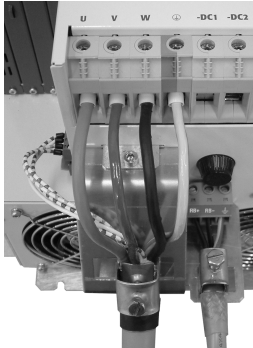
Shield connection for the motor cable using grounding clamps		
1022, 1045, 1090	1180, 1320	1640, 128M
		

Table 59: Grounding the motor cable

- ⑧ On the motor side, the cable shield for the motor line is connected to the motor housing using the motor plug and connected to ground via the machine.
The cable shield on the connection cable for the external braking resistor must be connected with the housing of the braking resistor.
- ⑨ On the motor side, the encoder cable shield is connected to the motor housing using the encoder plug and connected to ground via the machine.

1.2 Secure Restart Inhibit

1.2.1 General Information

ACOPOS servo drives have a built-in secure restart inhibit to guarantee that the device is stopped securely and to prevent it from restarting unexpectedly. It is designed to correspond to safety category 3 according to EN 954-1. ¹⁾

In addition to preventing the device from restarting unexpectedly according to EN 1037, this safety function also meets the requirements of EN 60204-1 regarding the stop function for categories 0 and 1. Both stop functions require the supply to the machine drives to be switched off (immediately for category 0 and after stopping for category 1).

The secure restart inhibit interrupts the supply to the motor by preventing the pulses to the IGBTs. In this way, a rotating field can no longer be creating in synchronous and asynchronous motors controlled by the ACOPOS servo drives. This fulfills the requirements of EN 1037 regarding preventing the device from starting unexpectedly and IEC 60204-1 regarding the stop function for categories 0 and 1. ²⁾

Danger!

Take note that multiple errors in the IGBT bridge can cause a short advancing movement. The maximum rotary angle of the advancing movement φ on the motor shaft depends on the motor used. For permanently excited synchronous motors, $\varphi = 360^\circ/2p$ (for B&R standard motors, $p = 3$ and the angle is therefore 60°). For three-phase current asynchronous motors, there is a relatively small angle of rotation, between 5° and 15° .

For applications, where this can be dangerous, the goal for protection cannot be obtained.

1) TÜV: Sample test for secure restart inhibit according to EN 954-1 category 3 is in preparation.

2) A detailed explanation of the standards and categories can be found in chapter 7 "Standards and Certifications".

Additional Function

The availability of the DC-DC converter output voltage can be requested from the microprocessor. If a voltage is not present, the generation of the modulation pattern is suppressed by the microprocessor.

Danger!

After activating the secure restart inhibit using terminals X1 / Enable and X1 / COM(8, 9), the motor is de-energized and therefore torque-free. If the motor was moving before activation of the secure restart inhibit, it is only stopped by an operational brake which is sometimes available or from the friction of the entire system. Therefore, the motor is not able to hold hanging loads. Holding brakes must be used for this purpose.

For applications, where this can be dangerous, the goal for protection cannot be obtained.

1.2.3 External Wiring

The following section contains four wiring suggestions for the external wiring of the secure restart inhibit. They are divided corresponding to the three stop functions (categories 0, 1 and 2) according to IEC 60204-1.

With the wiring shown, you can obtain safety category 3 according to EN 954-1 for the emergency stop function (for regular checks of the emergency stop function) and for secure restart inhibit.

In order for the wiring to meet the requirements of the respective application and the listed safety category according to EN 954-1, suitable switching devices – one or two pin e-stop switching devices from safety category 2 (reliable switching devices) - and cabling concepts must be used.

Danger!

To set up the e-stop function, one or two pin switching devices from safety category 2 (reliable switching devices) must be used in the e-stop chain. To obtain safety category 3 according to EN 954-1, the e-stop function must be checked once a day.

For applications where this is not possible, the goal for protection cannot be obtained.

Stop Function for Category 0 – Safety Category 3

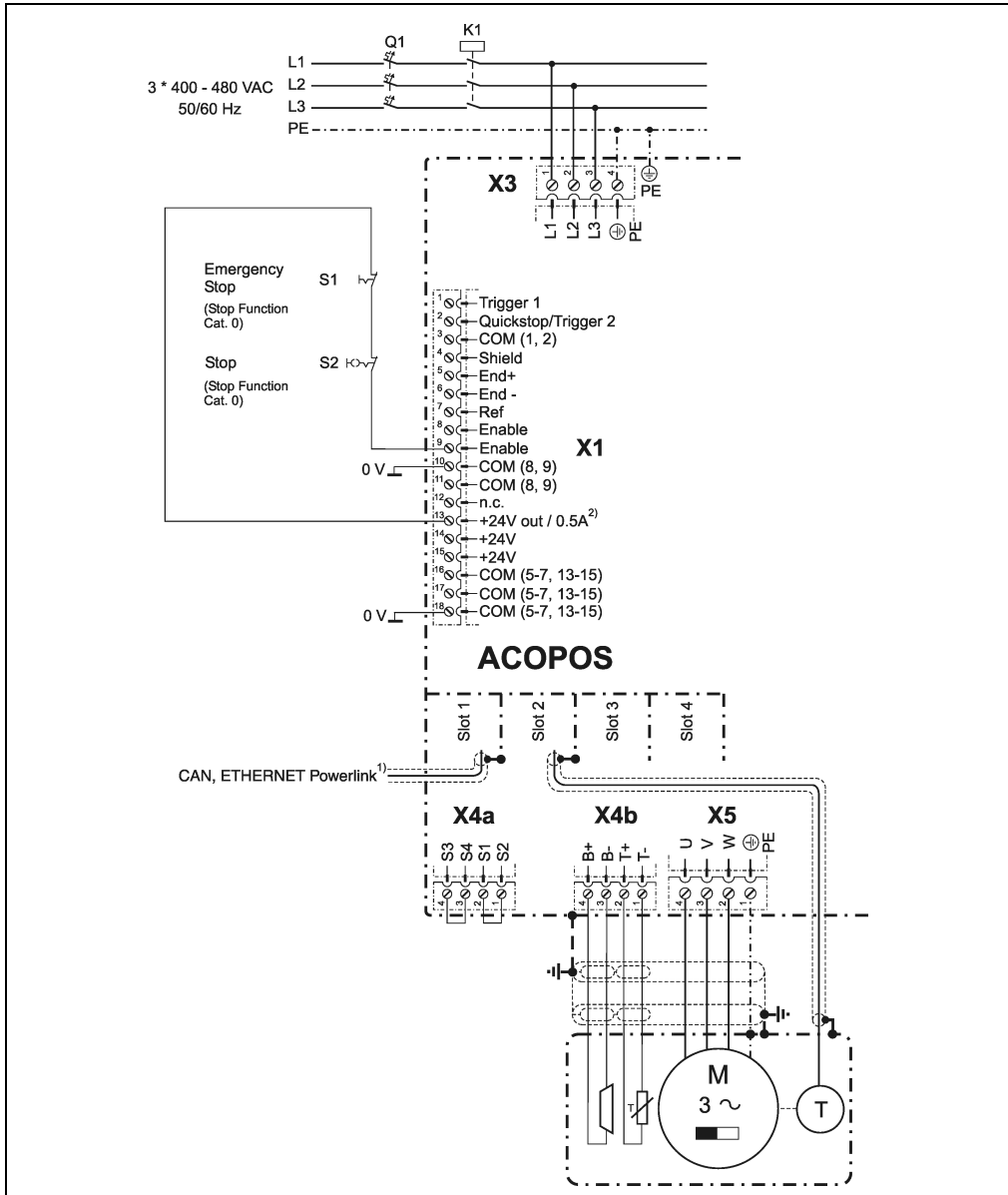


Figure 32: External wiring for the stop function in category 0 – safety category 3

1) The network connection is used for diagnosis and setting parameters.

2) For servo drives which have no 24 VDC output (ACOPOS 1022/1045/1090), the control voltage must be provided externally.

Description

By pressing the e-stop switch S1 (cat. 0 stop function) or the stop switch S2 (cat. 0 stop function), the drive has no torque and spins out.

This guarantees that the energy feed to the motor is **immediately switched off**.

If you open and lock stop switch S2, restart is inhibited.

Stop Function for Category 1 – Safety Category 3

Type 1 – Starting active braking over the network

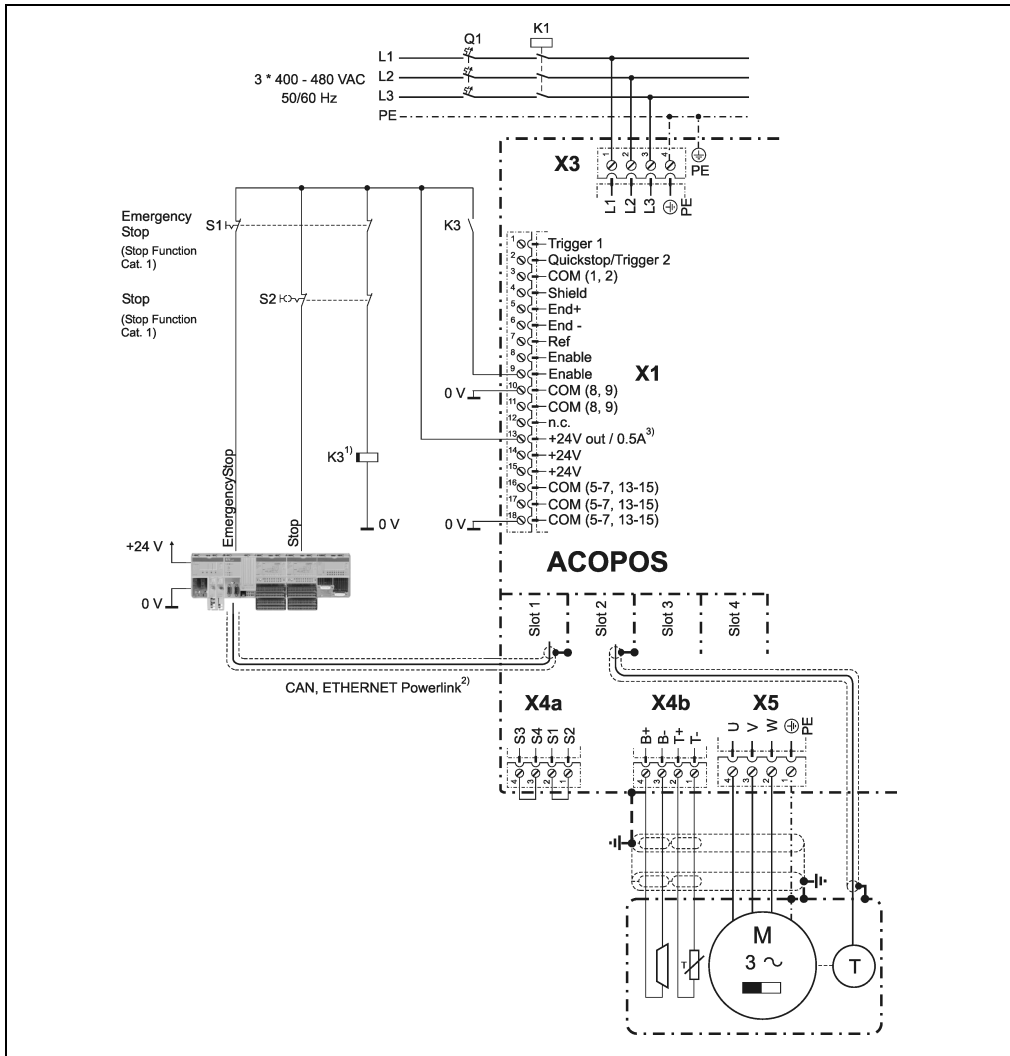


Figure 33: Type 1 – Starting active braking over the network

- 1) The drop-out time lag corresponds to the requirements of the application. The K3 auxiliary relay with drop-out time lag is a part of the safety function. Therefore K3 must meet safety category 3.
- 2) The network connection is used to transfer the interruption command for active braking, for diagnosis and setting parameters.
- 3) For servo drives which have no 24 VDC output (ACOPOS 1022/1045/1090), the control voltage must be provided externally.

Description

When the e-stop switch S1 (cat. 1 stop function) is pressed, the "EmergencyStop" control input on the controller triggers active braking (see following example code).

If the controller, the network, the drive, etc. is faulty, then auxiliary relay K3 is released after a defined delay and causes the energy feed to the motor to be cut off.

Pressing stop switch S2 (cat. 1 stop function) basically triggers the same procedure, but is handled differently by the software (separate digital input "Stop").

This guarantees that the energy feed to the motor is definitely **switched off afterwards**.

If you open and lock stop switch S2, restart is inhibited.

Example Code

Trigger the stop command (via CAN bus or ETHERNET Powerlink).

```
if ( ! stop_active )
{
  /* Movement stop not active: Test stop inputs */
  if ( EmergencyStop == ncLOW )
  {
    /* Movement stop with parameter set for "emergency stop" activated */
    stop_index = E_STOP_INDEX;
    step = MOV_STOP;
    stop_active = 1;
  }
  else if ( Stop == ncLOW )
  {
    /* Movement stop with parameter set for "stop" activated */
    stop_index = STOP_INDEX;
    step = MOV_STOP;
    stop_active = 1;
  }
}
else
{
  /* Movement stop was activated */
  if ( EmergencyStop == ncHIGH && Stop == ncHIGH && step!= W_MOV_STOP )
  {
    /* Movement stop completed */
    stop_active = 0;
  }
}
```

```

switch(step)
{
    ...
    case MOV_STOP:
        /* Call NC action for movement stop */
        p_ax_dat->move.stop.index.command = stop_index;

        action_status = naction(ax_obj,ncMOVE,ncSTOP);
        if ( action_status == ncOK )
        {
            step = W_MOVE_STOP;
        }
        break;

    case W_MOVE_STOP:
        /* Wait for completion of movement stop */
        if (p_ax_dat->move.mode == ncOFF)
        {
            /* Movement stop completed */
            step = <NEXT_STEP>
        }
        break;
    ...
}

```

Type 2 – Starting active braking using the Quickstop input on the ACOPOS

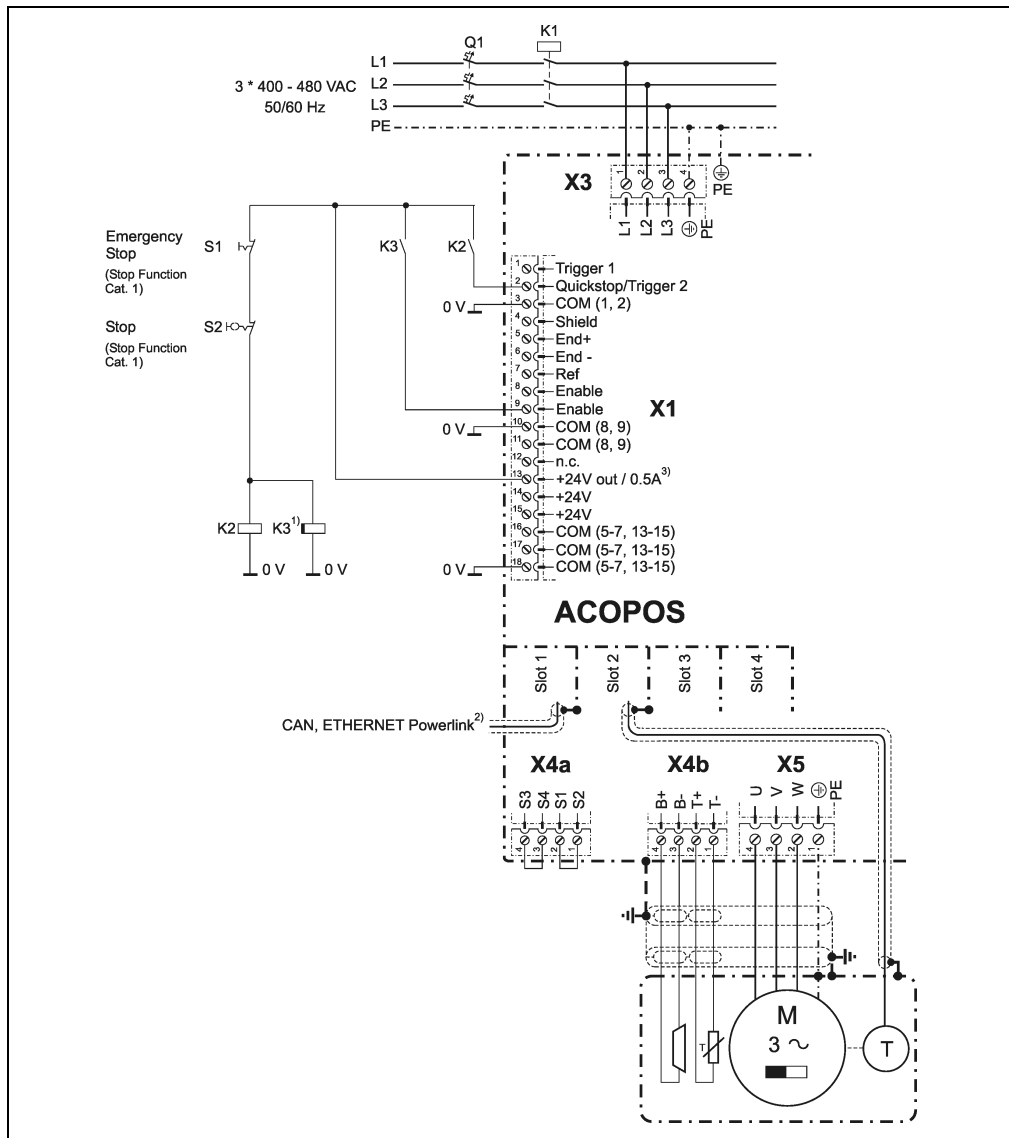


Figure 34: Type 2 – Starting active braking using the Quickstop-input on the ACOPOS

- 1) The drop-out time lag corresponds to the requirements of the application. The K3 auxiliary relay with drop-out time lag is a part of the safety function. Therefore K3 must meet safety category 3.
- 2) The network connection is used for diagnosis and setting parameters.
- 3) For servo drives which have no 24 VDC output (ACOPOS 1022/1045/1090), the control voltage must be provided externally.

Description

Pressing e-stop switch S1 (cat. 1 stop function) causes relay K2 to be released. In this way, the ACOPOS input "Quickstop" triggers active braking.

If the drive, etc. is faulty, then auxiliary relay K3 is released after a defined delay and causes the energy feed to the motor to be cut off.

Pressing stop switch S2 (cat. 1 stop function) starts the same procedure as for type 1.

This guarantees that the energy feed to the motor is definitely **switched off afterwards**.

If you open and lock stop switch S2, restart is inhibited.

Stop Function for Category 2 – Safety Category 3

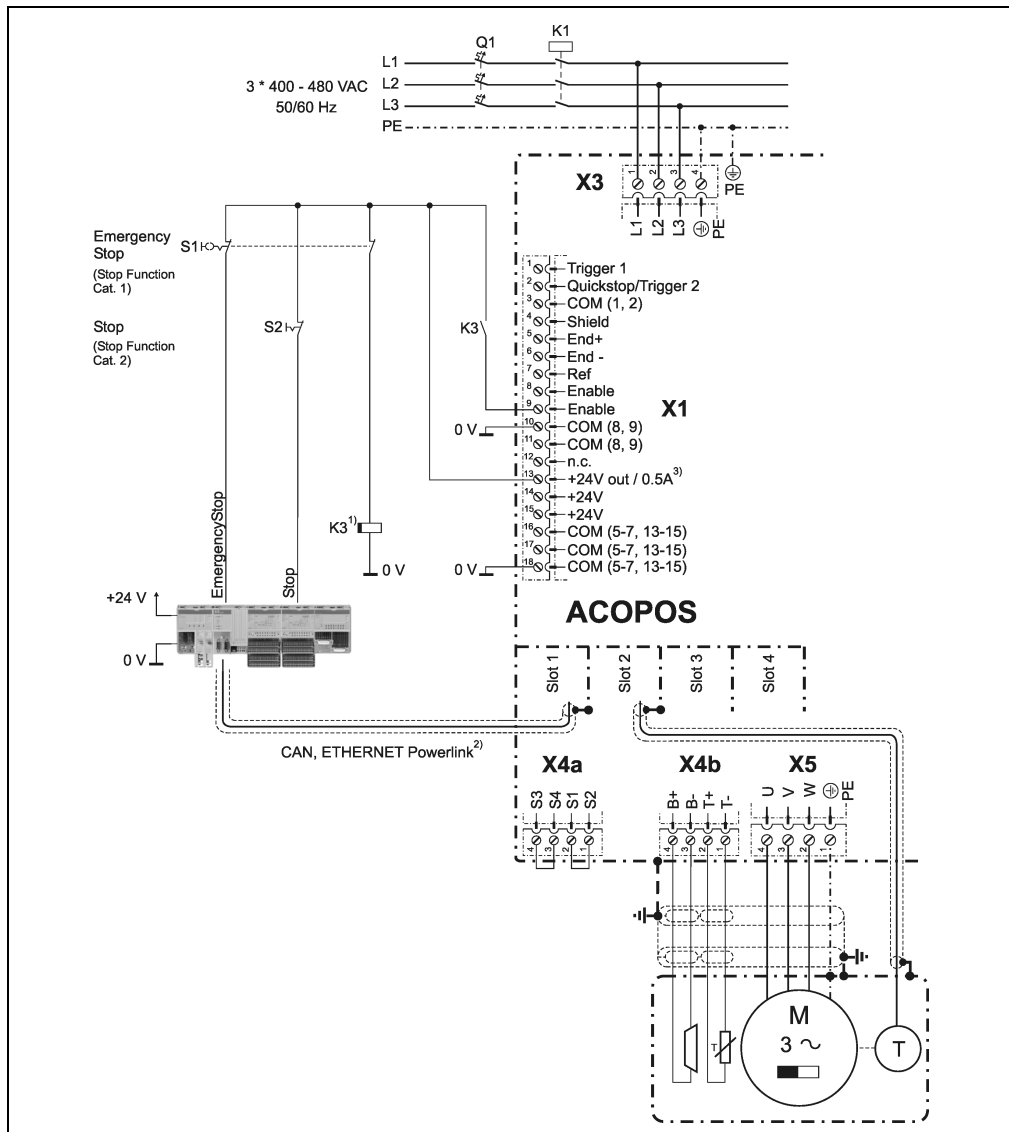


Figure 35: External wiring for the stop function in category 2 – safety category 3

- 1) The drop-out time lag corresponds to the requirements of the application. The K3 auxiliary relay with drop-out time lag is a part of the safety function. Therefore K3 must meet safety category 3.
- 2) The network connection is used to transfer the interruption command for active braking, for diagnosis and setting parameters.
- 3) For servo drives which have no 24 VDC output (ACOPOS 1022/1045/1090), the control voltage must be provided externally.

Description

When the e-stop switch S1 (cat. 1 stop function) is pressed, the "EmergencyStop" control input on the controller triggers active braking (see "Example Code" on page 132).

If the controller, the network, the drive, etc. is faulty, then auxiliary relay K3 is released after a defined delay and causes the energy feed to the motor to be cut off.

Pressing stop switch S2 (cat. 2 stop function) basically triggers the same procedure, but is handled differently by the software (separate digital input "Stop"). However, the energy feed to the motor is **not switched off** after stopping.

If you open and lock e-stop switch S1, restart is inhibited.

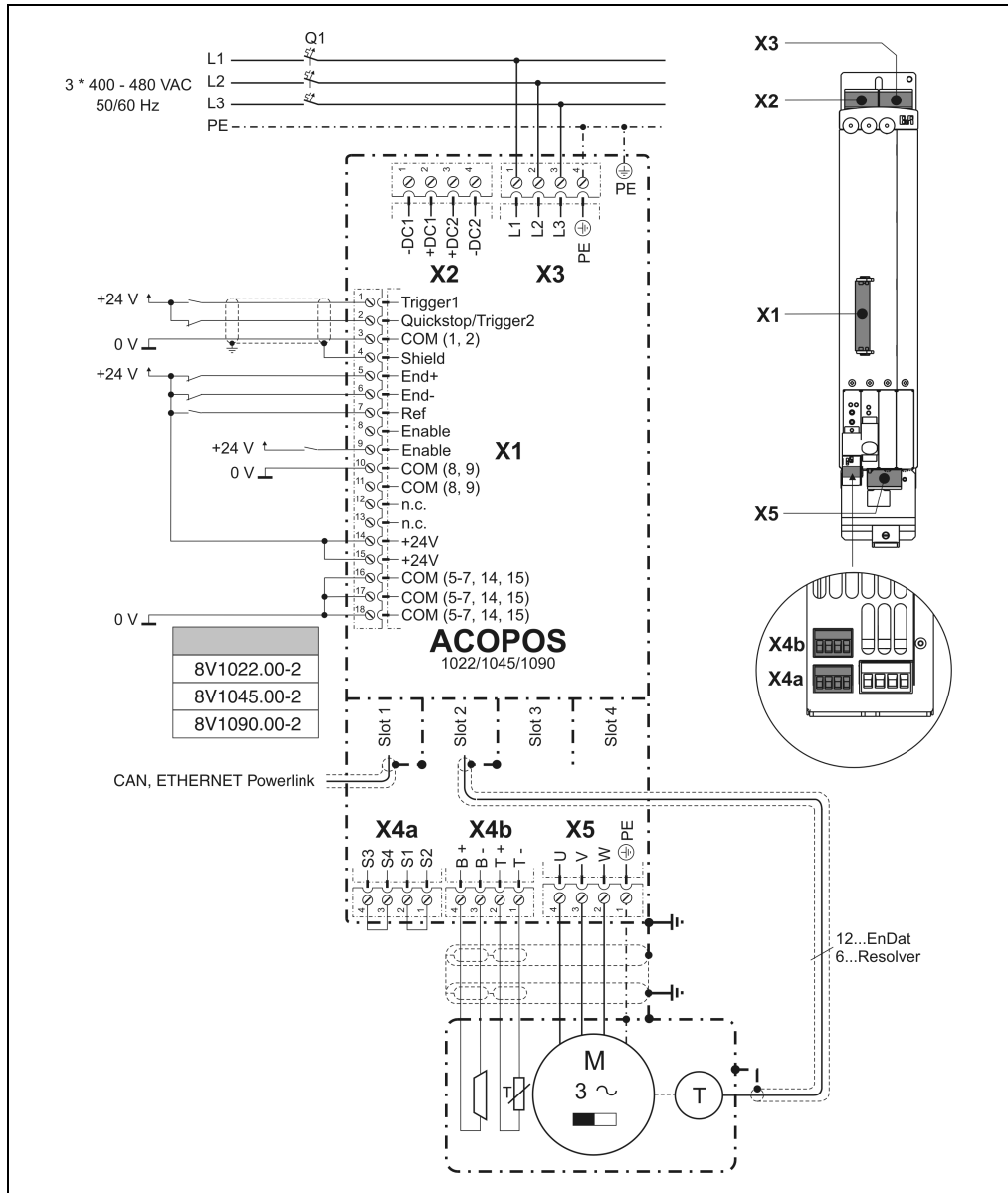
1.3 Overview of the Terminal Cross Sections ¹⁾

Terminal Cross Sections		8V1022.00-2 8V1045.00-2 8V1090.00-2		8V1180.00-2 8V1320.00-2		8V1640.00-2		8V128M.00-2	
		[mm ²]	[AWG]	[mm ²]	[AWG]	[mm ²]	[AWG]	[mm ²]	[AWG]
X1	Solid core/multiple conductor lines	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14
	Flexible and fine wire lines without Wire Tip Sleeves	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14
	Flexible and fine wire lines with Wire Tip Sleeves	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14	0.5 - 1.5	20 - 14
	Approbation Data UL/C-UL-US CSA	---	26 - 14 26 - 14	---	26 - 14 26 - 14	---	26 - 14 26 - 14	---	26 - 14 26 - 14
Holding Torque for the Terminal Screws [Nm]		0.2 ... 0.25		0.2 ... 0.25		0.2 ... 0.25		0.2 ... 0.25	
X2 DC Bus	Solid core/multiple conductor lines	0.2 - 4	24 - 10	0.5 - 10	20 - 7	10 - 50	7 - 0	16 - 95	6 - 3/0
	Flexible and fine wire lines without Wire Tip Sleeves	0.2 - 4	24 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	Flexible and fine wire lines with Wire Tip Sleeves	0.25 - 4	23 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	Approbation Data UL/C-UL-US CSA	---	30 - 10 28 - 10	---	20 - 8 20 - 8	---	10 - 2 12 - 2	---	6 - 2/0 6 - 2/0
Holding Torque for the Terminal Screws [Nm]		0.5 ... 0.6		1.2 ... 1.5		3 ... 4		6 ... 10	
X3 Power mains	Solid core/multiple conductor lines	0.2 - 4	24 - 10	0.5 - 10	20 - 7	10 - 50	7 - 0	16 - 95	6 - 3/0
	Flexible and fine wire lines without Wire Tip Sleeves	0.2 - 4	24 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	Flexible and fine wire lines with Wire Tip Sleeves	0.25 - 4	23 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	Approbation Data UL/C-UL-US CSA	---	30 - 10 28 - 10	---	20 - 8 20 - 8	---	10 - 2 12 - 2	---	6 - 2/0 6 - 2/0
Holding Torque for the Terminal Screws [Nm]		0.5 ... 0.6		1.2 ... 1.5		3 ... 4		6 ... 10	
X4a, X4b Motor (holding brake, temperature sensor)	Solid core/multiple conductor lines	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12
	Flexible and fine wire lines without Wire Tip Sleeves	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12	0.2 - 2.5	24 - 12
	Flexible and fine wire lines with Wire Tip Sleeves	0.25 - 2.5	23 - 12	0.25 - 2.5	23 - 12	0.25 - 2.5	23 - 12	0.25 - 2.5	23 - 12
	Approbation Data UL/C-UL-US CSA	---	30 - 12 28 - 12	---	30 - 12 28 - 12	---	30 - 12 28 - 12	---	30 - 12 28 - 12
Holding Torque for the Terminal Screws [Nm]		0.5 ... 0.6		0.5 ... 0.6		0.5 ... 0.6		0.5 ... 0.6	
X5 Motor (power)	Solid core/multiple conductor lines	0.2 - 4	24 - 10	0.5 - 10	20 - 7	10 - 50	7 - 0	16 - 95	6 - 3/0
	Flexible and fine wire lines without Wire Tip Sleeves	0.2 - 4	24 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	Flexible and fine wire lines with Wire Tip Sleeves	0.25 - 4	23 - 10	0.5 - 6	20 - 9	10 - 35	7 - 2	10 - 70	7 - 2/0
	Approbation Data UL/C-UL-US CSA	---	30 - 10 28 - 10	---	20 - 8 20 - 8	---	10 - 2 12 - 2	---	6 - 2/0 6 - 2/0
Holding Torque for the Terminal Screws [Nm]		0.5 ... 0.6		1.2 ... 1.5		3 ... 4		6 ... 10	
X6 External Brake Resistor	Solid core/multiple conductor lines	---	---	0.2 - 4	24 - 10	0.5 - 10	20 - 7	0.5 - 10	20 - 7
	Flexible and fine wire lines without Wire Tip Sleeves	---	---	0.2 - 4	24 - 10	0.5 - 6	20 - 9	0.5 - 6	20 - 9
	Flexible and fine wire lines with Wire Tip Sleeves	---	---	0.25 - 4	23 - 10	0.5 - 6	20 - 9	0.5 - 6	20 - 9
	Approbation Data UL/C-UL-US CSA	---	---	---	30 - 10 28 - 10	---	20 - 8 20 - 8	---	20 - 8 20 - 8
Holding Torque for the Terminal Screws [Nm]		---		0.5 ... 0.6		1.2 ... 1.5		1.2 ... 1.5	

Table 60: Terminal cross sections for ACOPOS servo drives

1) ACOPOS 1022/1045/1090 revision I0 and up; ACOPOS 1180/1320 revision F0 and up; ACOPOS 1640/128M revision K0 and up.

2. Pin Assignments ACOPOS 1022, 1045, 1090 ¹⁾



2.1 Pin Assignments for Plug X1

X1	Pin	Description	Function
	1	Trigger1	Trigger 1
	2	Quickstop/Trigger2	Quickstop/Trigger 2
	3	COM (1, 2)	Trigger 1, Quickstop/Trigger 2 - 0 V
	4	Shield	Shield
	5	End+	Positive HW limit
	6	End-	Negative HW limit
	7	Ref	Reference switch
	8	Enable	Enable
	9	Enable	Enable
	10	COM (8, 9)	Enable 0 V
	11	COM (8, 9)	Enable 0 V
	12	---	---
	13	---	---
	14	+24V	Supply +24 V
	15	+24V	Supply +24 V
	16	COM (5-7, 14, 15)	Supply 0 V
	17	COM (5-7, 14, 15)	Supply 0 V
	18	COM (5-7, 14, 15)	Supply 0 V
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 61: Pin assignments for plug X1 ACOPOS 1022, 1045, 1090

2.2 Pin Assignments for Plug X2

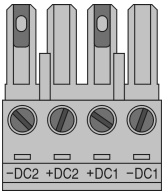
X2	Pin	Description	Function
	1	-DC1	U DC bus -
	2	+DC1	U DC bus +
	3	+DC2	U DC bus +
	4	-DC2	U DC bus -
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 62: Pin assignments for plug X2 ACOPOS 1022, 1045, 1090

2.3 Pin Assignments for Plug X3

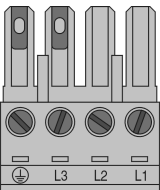
X3	Pin	Description	Function
	1	L1	Power mains connection L1
	2	L2	Power mains connection L2
	3	L3	Power mains connection L3
	4	PE	Protective ground conductor
	Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138		

Table 63: Pin assignments for plug X3 ACOPOS 1022, 1045, 1090

2.4 Pin assignments for plugs X4a, X4b

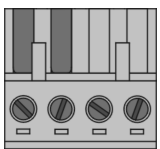
X4a	Pin	Description	Function
	1	S2	Activation, supply for the external holding brake (+)
	2	S1	Activation for the external holding brake (+)
	3	S4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
	Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138		

Table 64: Pin assignments for plug X4a ACOPOS 1022, 1045, 1090

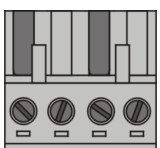
X4b	Pin	Description	Function
	1	T-	Temperature Sensor -
	2	T+	Temperature Sensor +
	3	B-	Brake -
	4	B+	Brake +
	Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138		

Table 65: Pin assignments for plug X4b ACOPOS 1022, 1045, 1090

2.4.1 Wiring the Output for the Motor Holding Brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the the X4a connector in three different ways:

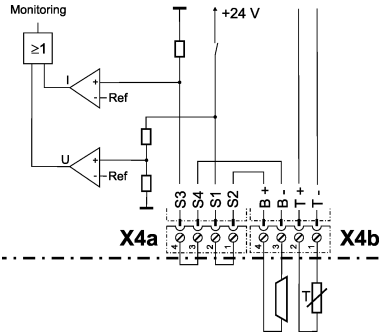
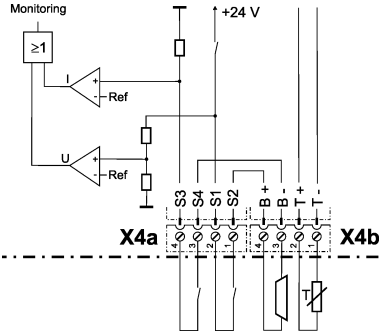
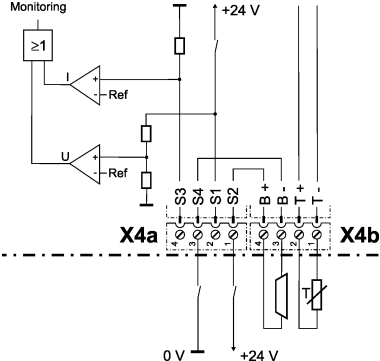
	Image	Description
1		• Supply: Internally by the ACOPOS servo drive • Activation: Internally by the ACOPOS servo drive • Monitoring: Internally by the ACOPOS servo drive A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. ¹⁾
2		• Supply: Internally by the ACOPOS servo drive • Activation: Internally by the ACOPOS servo drive and also possible externally using potential free contacts ²⁾ • Monitoring: Internally by the ACOPOS servo drive Information: The parameters for ACOPOS internal monitoring must be set according to the requirements of the application. ³⁾
3		• Supply: External • Activation: External • Monitoring: External Information: ACOPOS internal monitoring cannot be used here; therefore it must be deactivated using software. ⁴⁾

Table 66: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.

2) External potential free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.

3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).

4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

2.5 Pin Assignments for Plug X5

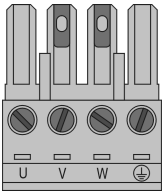
X5	Pin	Description	Function
	1	PE	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	E	Motor connection U
	Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138		

Table 67: Pin assignments for plug X5 ACOPOS 1022, 1045, 1090

2.6 Protective Ground Connection (PE)

The protective ground conductor is connected to the threaded bolt M5 provided using a cable lug. For information concerning dimensioning see section 1.1.3 "Protective Ground Connection (PE)", on page 98.

Image	Pin	Description	Function
	---	PE	Protective ground conductor
Terminal Cross Sections	[mm ²]		AWG
Cable lug for threaded bolt M5	0.25 - 16		23 - 5

Table 68: Protective ground conductor (PE) ACOPOS 1022, 1045, 1090

Danger!

Before turning on the servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be made, even when testing the servo drive or when operating it for a short time!

3. Pin Assignments ACOPOS 1180, 1320 ¹⁾

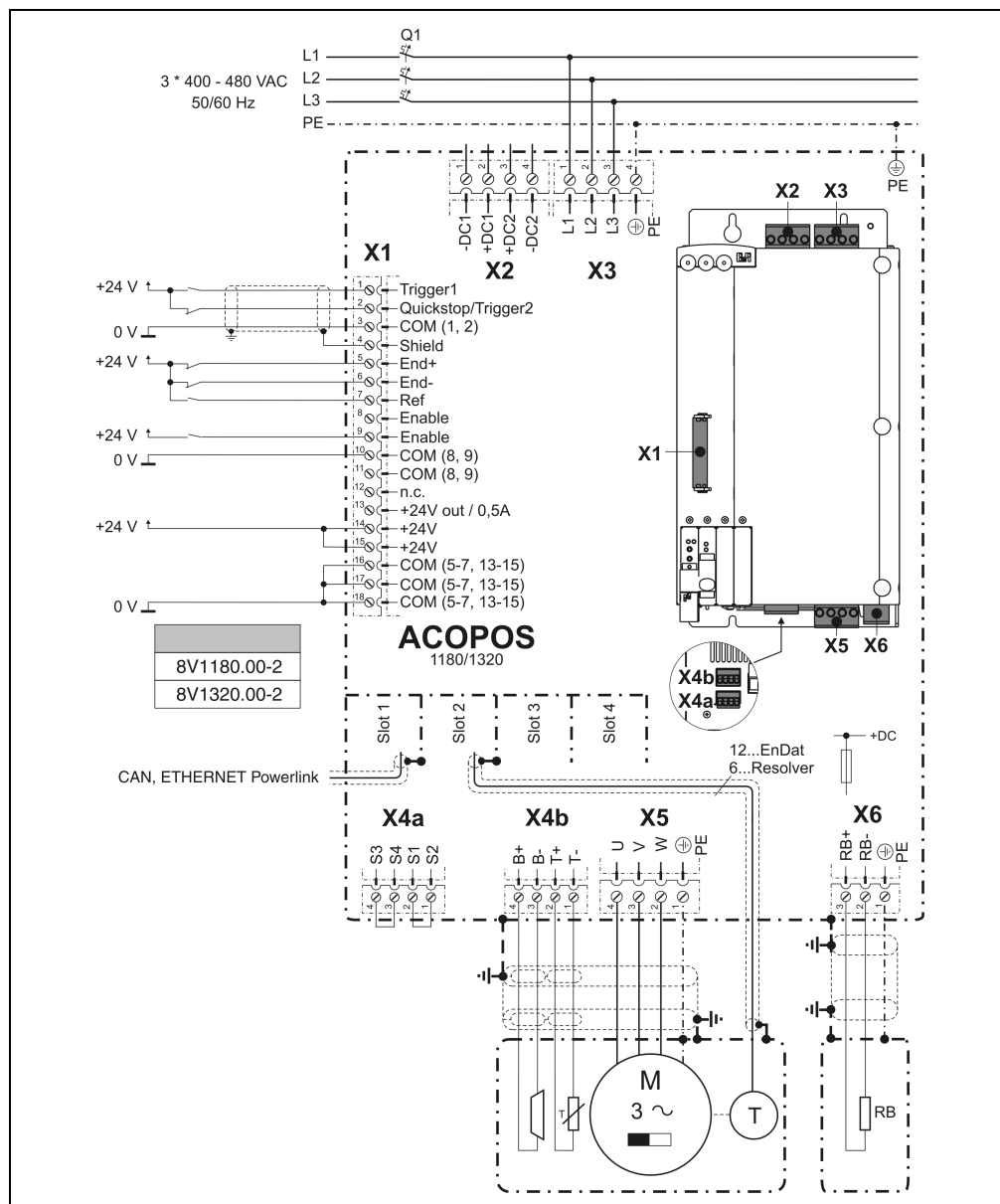


Figure 37: Pin assignment overview ACOPOS 1180, 1320

¹⁾ Starting with revision F0.

3.1 Pin Assignments for Plug X1

X1	Pin	Description	Function
	1	Trigger1	Trigger 1
	2	Quickstop/Trigger2	Quickstop/Trigger 2
	3	COM (1, 2)	Trigger 1, Quickstop/Trigger 2 - 0 V
	4	Shield	Shield
	5	End+	Positive HW limit
	6	End-	Negative HW limit
	7	Ref	Reference switch
	8	Enable	Enable
	9	Enable	Enable
	10	COM (8, 9)	Enable 0 V
	11	COM (8, 9)	Enable 0 V
	12	---	---
	13	+24V out / 0.5A	+24 V output / 0.5 A
	14	+24V	Supply +24 V
	15	+24V	Supply +24 V
	16	COM (5-7, 13-15)	Supply 0 V
	17	COM (5-7, 13-15)	Supply 0 V
	18	COM (5-7, 13-15)	Supply 0 V
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 69: Pin assignments for plug X1 ACOPOS 1180, 1320

3.2 Pin Assignments for Plug X2

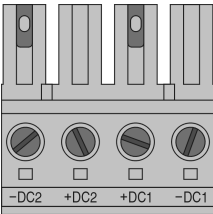
X2	Pin	Description	Function
	1	-DC1	U DC bus -
	2	+DC1	U DC bus +
	3	+DC2	U DC bus +
	4	-DC2	U DC bus -
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 70: Pin assignments for plug X2 ACOPOS 1180, 1320

3.3 Pin Assignments for Plug X3

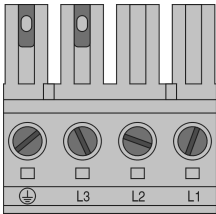
X3	Pin	Description	Function
	1	L1	Power mains connection L1
	2	L2	Power mains connection L2
	3	L3	Power mains connection L3
	4	PE	Protective ground conductor
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 71: Pin assignments for plug X3 ACOPOS 1180, 1320

3.4 Pin Assignments for Plugs X4a, X4b

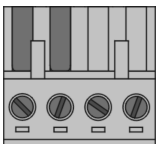
X4a	Pin	Description	Function
	1	S2	Activation, supply for the external holding brake (+)
	2	S1	Activation for the external holding brake (+)
	3	S4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 72: Pin assignments for plug X4a ACOPOS 1180, 1320

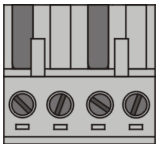
X4b	Pin	Description	Function
	1	T-	Temperature Sensor -
	2	T+	Temperature Sensor +
	3	B-	Brake -
	4	B+	Brake +
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 73: Pin assignments for plug X4b ACOPOS 1180, 1320

3.4.1 Wiring the Output for the Motor Holding Brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the the X4a connector in three different ways:

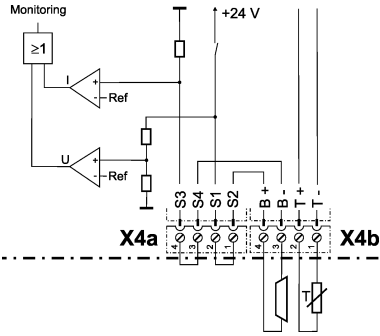
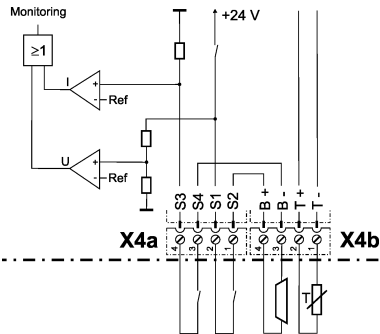
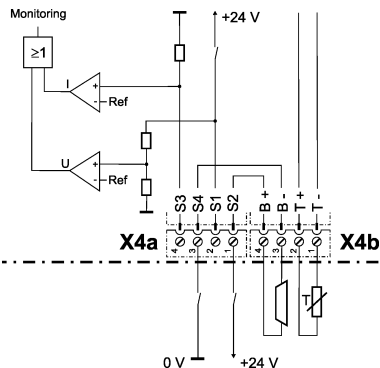
	Image	Description
1		• Supply: Internally by the ACOPOS servo drive • Activation: Internally by the ACOPOS servo drive • Monitoring: Internally by the ACOPOS servo drive A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. ¹⁾
2		• Supply: Internally by the ACOPOS servo drive • Activation: Internally by the ACOPOS servo drive and also possible externally using potential free contacts ²⁾ • Monitoring: Internally by the ACOPOS servo drive Information: The parameters for ACOPOS internal monitoring must be set according to the requirements of the application. ³⁾
3		• Supply: External • Activation: External • Monitoring: External Information: ACOPOS internal monitoring cannot be used here; therefore it must be deactivated using software. ⁴⁾

Table 74: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.

2) External potential free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.

3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).

4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

3.5 Pin Assignments for Plug X5

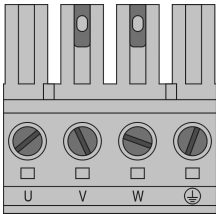
X5	Pin	Description	Function
	1	PE	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	E	Motor connection U
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 75: Pin assignments for plug X5 ACOPOS 1180, 1320

3.6 Pin Assignments for Plug X6

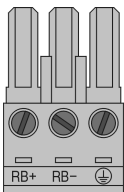
X6	Pin	Description	Function
	1	PE	Protective ground conductor
	2	RB-	Brake Resistance -
	3	RB+	Brake Resistance +
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 76: Pin assignments for plug X6 ACOPOS 1180, 1320

3.7 Protective Ground Connection (PE)

The protective ground conductor is connected to the threaded bolt M5 provided using a cable lug. For information concerning dimensioning see section 1.1.3 "Protective Ground Connection (PE)", on page 98.

Image	Pin	Description	Function
	---	PE	Protective ground conductor
Terminal Cross Sections	[mm ²]		AWG
Cable lug for threaded bolt M5	0.25 - 16		23 - 5

Table 77: Protective ground conductor (PE) ACOPOS 1180, 1320

Danger!

Before turning on the servo drive, make sure that the housing is properly connected to ground (PE rail). The ground connection must be made, even when testing the servo drive or when operating it for a short time!



1) Starting with revision K0.

4.1 Pin Assignments for Plug X1

X1	Pin	Description	Function
	1	Trigger1	Trigger 1
	2	Quickstop/Trigger2	Quickstop/Trigger 2
	3	COM (1, 2)	Trigger 1, Quickstop/Trigger 2 - 0 V
	4	Shield	Shield
	5	End+	Positive HW limit
	6	End-	Negative HW limit
	7	Ref	Reference switch
	8	Enable	Enable
	9	Enable	Enable
	10	COM (8, 9)	Enable 0 V
	11	COM (8, 9)	Enable 0 V
	12	---	---
	13	+24V out / 0.5A	+24 V output / 0.5 A
	14	+24V	Supply +24 V
	15	+24V	Supply +24 V
	16	COM (5-7, 13-15)	Supply 0 V
	17	COM (5-7, 13-15)	Supply 0 V
	18	COM (5-7, 13-15)	Supply 0 V
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 78: Pin assignments for plug X1 ACOPOS 1640, 128M

4.2 Pin Assignments X2

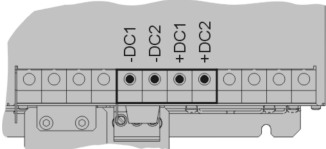
X2	Pin	Description	Function
	1	+DC2	U DC bus +
	2	+DC1	U DC bus +
	3	-DC2	U DC bus -
	4	-DC1	U DC bus -
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 79: Pin assignments for X2 ACOPOS 1640, 128M

4.3 Pin Assignments X3

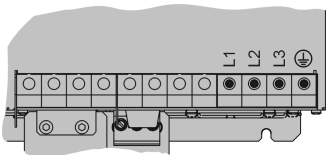
X3	Pin	Description	Function
	1	L1	Power mains connection L1
	2	L2	Power mains connection L2
	3	L3	Power mains connection L3
	4		Protective ground conductor
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 80: Pin assignments for X3 ACOPOS 1640, 128M

4.4 Pin Assignments for Plugs X4a, X4b

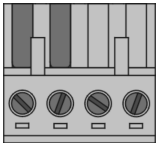
X4a	Pin	Description	Function
 S3 S4 S1 S2	1	S2	Activation, supply for the external holding brake (+)
	2	S1	Activation for the external holding brake (+)
	3	S4	Activation, supply for the external holding brake (-)
	4	S3	Activation for the external holding brake (-)
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 81: Pin assignments for plug X4a ACOPOS 1640, 128M

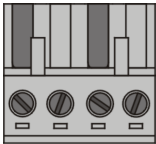
X4b	Pin	Description	Function
 B+ B- T+ T-	1	T-	Temperature Sensor -
	2	T+	Temperature Sensor +
	3	B-	Brake -
	4	B+	Brake +
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 82: Pin assignments for plug X4b ACOPOS 1640, 128M

4.4.1 Wiring the Output for the Motor Holding Brake

The supply, activation and monitoring of the output for the motor holding brake can take place via the the X4a connector in three different ways:

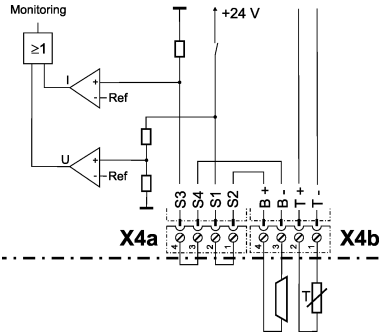
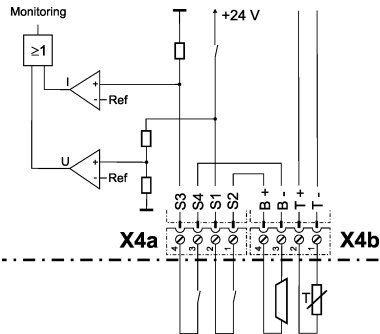
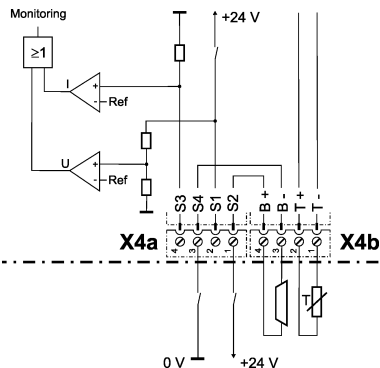
	Image	Description
1		• Supply: Internally by the ACOPOS servo drive • Activation: Internally by the ACOPOS servo drive • Monitoring: Internally by the ACOPOS servo drive A jumper must be placed between S1 and S2 as well as S3 and S4 on the X4a connector. ¹⁾
2		• Supply: Internally by the ACOPOS servo drive • Activation: Internally by the ACOPOS servo drive and also possible externally using potential free contacts ²⁾ • Monitoring: Internally by the ACOPOS servo drive Information: The parameters for ACOPOS internal monitoring must be set according to the requirements of the application. ³⁾
3		• Supply: External • Activation: External • Monitoring: External Information: ACOPOS internal monitoring cannot be used here; therefore it must be deactivated using software. ⁴⁾

Table 83: Activation for the external holding brake

1) Both jumpers are already on the X4a connector delivered with the ACOPOS servo drives.

2) External potential free contacts can be connected between S1 and S2 as well as between S3 and S4. This makes it possible to activate the holding brake using an external safety circuit independent of the control integrated in the ACOPOS servo drive.

3) The parameters are set using ParID 90 (1 ... internal monitoring active; 5 ... internal monitoring not active).

4) Deactivation takes place using ParID 90 (5 ... internal monitoring not active).

4.5 Pin Assignments X5

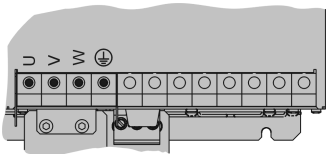
X5	Pin	Description	Function
	1	PE	Protective ground conductor
	2	W	Motor connection W
	3	V	Motor connection V
	4	E	Motor connection U
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 84: Pin assignments for X5 ACOPOS 1640, 128M

4.6 Pin Assignments X6

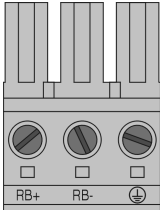
X6	Pin	Description	Function
	1	PE	Protective ground conductor
	2	RB-	Brake Resistance -
	3	RB+	Brake Resistance +
Terminal Cross Sections see table 60 "Terminal cross sections for ACOPOS servo drives", on page 138			

Table 85: Pin assignments for X6 ACOPOS 1640, 128M

5. Pin Assignments Plug-in Modules

5.1 AC110 - CAN Interface

5.1.1 Pin Assignments

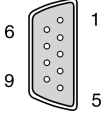
Image	X1	Pin	Description	Function
 AC 110 RXD TXD	 6 1 9 5	1	---	---
		2	CAN_L	CAN Low
		3	COM (2, 7)	CAN 0 V
		4	---	---
		5	---	---
		6	---	---
		7	CAN_H	CAN High
		8	---	---
		9	---	---

Table 86: Pin assignments for AC110 - CAN Interface

5.2 AC112 - ETHERNET Powerlink Interface

5.2.1 Pin Assignments

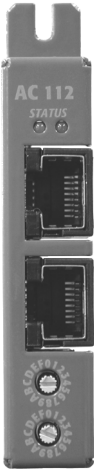
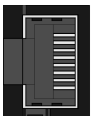
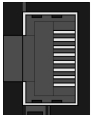
Image	X1	Pin	Description	Function
		1	RXD	Receive Signal
		2	RXD\	Receive Signal Inverted
		3	TXD	Transmit Signal
		4	Shield	Shield
		5	Shield	Shield
		6	TXD\	Transmit Signal Inverted
		7	Shield	Shield
		8	Shield	Shield
	X2	Pin	Description	Function
		1	RXD	Receive Signal
		2	RXD\	Receive Signal Inverted
		3	TXD	Transmit Signal
		4	Shield	Shield
		5	Shield	Shield
		6	TXD\	Transmit Signal Inverted
		7	Shield	Shield
		8	Shield	Shield

Table 87: Pin assignments for AC112 - ETHERNET Powerlink Interface

Information:

In general, crossover Ethernet cables must be used for ETHERNET Powerlink connections!

Take care when plugging the cable in and out because otherwise the shield connection could break between the RJ45 plug and the cable shield which could then cause connection disturbances!

Information:

ETHERNET Powerlink cables must have crossover pin assignments. Unassigned wires cannot be omitted.

5.3 AC120 - EnDat Encoder Interface

5.3.1 Pin Assignments

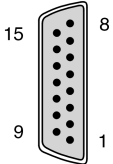
Image	X1	Pin	Description	Function in EnDat mode	Function in Incremental mode
		1	A	Channel A	
		2	COM (1, 3 - 9, 11, 13 - 15)	Encoder supply 0 V	
		3	B	Channel B	
		4	+5V out / 0.25A	Encoder supply +5 V	
		5	D	Data input	---
		6	---	---	
		7	R\	---	Reference pulse inverted
		8	T	Clock output	---
		9	A\	Channel A inverted	
		10	Sense COM	Sense input 0 V	
		11	B\	Channel B inverted	
		12	Sense +5V	Sense input +5 V	
		13	D\	Data inverted	---
		14	R	---	Reference Pulse
		15	T\	Clock output inverted	---

Table 88: Pin assignments for AC120 - EnDat encoder interface

5.4 AC122 - Resolver Interface

5.4.1 Pin Assignments

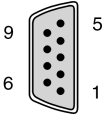
Image	X1	Pin	Description	Function
 The image shows the AC 122 module, a vertical black component with a D-sub 9-pin connector at the bottom. Above the connector are two push-buttons labeled 'UP' and 'DN'. The module is labeled 'AC 122'.	 The diagram shows a 9-pin connector with pins numbered 1 through 9. Pin 1 is at the bottom right, pin 5 is at the top right, pin 9 is at the top left, and pin 6 is at the bottom left.	1	---	---
		2	---	---
		3	Cos	Cosine input
		4	Sin	Sine input
		5	Ref	Reference output
		6	---	---
		7	Cos\	Cosine input inverted
		8	Sin\	Sine input inverted
		9	Ref \	Reference output inverted

Table 89: Pin assignments for AC122 - resolver interface

5.5 AC123 - Incremental Encoder and SSI Absolute Encoder Interface

5.5.1 Pin Assignments

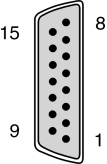
Image	X1	Pin	Description	Function in Incremental mode	Function in SSI mode
 The image shows the AC123 module on the left and a diagram of the X1 connector on the right. The X1 connector is a 15-pin D-sub connector. The pinout diagram shows pins 1 through 15, with pins 1, 8, 9, and 15 labeled. The pins are arranged in a 15-pin D-sub connector with pins 1, 8, 9, and 15 labeled.	 The diagram shows the X1 connector pinout. Pins 1, 8, 9, and 15 are labeled. The pins are arranged in a 15-pin D-sub connector with pins 1, 8, 9, and 15 labeled.	1	A	Channel A	---
		2	A\	Channel A inverted	---
		3	B	Channel B	---
		4	B\	Channel B inverted	---
		5	RD	Reference Pulse	Data input
		6	RD\	Reference pulse inverted	Data input inverted
		7	T	---	Clock output
		8	T\	---	Clock output inverted
		9	+5V out / 0.35A	Encoder supply +5 V	
		10	Sense +5V	Sense +5 V	
		11	Sense COM	Sense 0 V	
		12	COM (7 - 9, 13)	Encoder supply 0 V	
		13	+15V out / 0.35A	Encoder supply +15 V	
		14	A1	Activate encoder supply ¹⁾	
		15	A2	Activate encoder supply ¹⁾	

Table 90: Pin assignments AC123 - incremental encoder and SSI absolute encoder interface

1) To activate the encoder supply, pins 14 and 15 must be connected in the encoder cable plug.

5.6 AC130 - Digital Mixed Module

5.6.1 Pin Assignments

Image	X1	Pin	Description	Function
		1	Digital I/O 1	Digital input / output 1
		2	Digital I/O 2	Digital input / output 2
		3	Digital I/O 3	Digital input / output 3
		4	Digital I/O 4	Digital input / output 4
		5	Digital I/O 5	Digital input / output 5
		6	Digital I/O 6	Digital input / output 6
		7	Digital I/O 7	Digital input / output 7
		8	Digital I/O 8	Digital input / output 8
		9	Digital O 9	Digital output 9
		10	Digital O 10	Digital output 10
		11	+24V	Supply +24 V
		12	COM (1-11)	Supply 0 V
Terminal Cross Sections		[mm²]	[AWG]	
Solid Core / Multiple Conductor Lines		0.5 - 1.5	20 - 14	
Flexible, Multiple Conductor Line without Wire Tip Sleeves		0.5 - 1.5	20 - 14	
with Wire Tip Sleeves		0.5 - 1.5	20 - 14	
Approval Data (UL/C-UL-US- and CSA)				
UL/C-UL-US		---	26 - 14	
CSA		---	26 - 14	
Holding Torque for the Terminal Screws [Nm]		0.2 ... 0.25		

Table 91: Pin assignments AC130 - digital mixed module

5.7 AC131 - Mixed Module

5.7.1 Pin Assignments

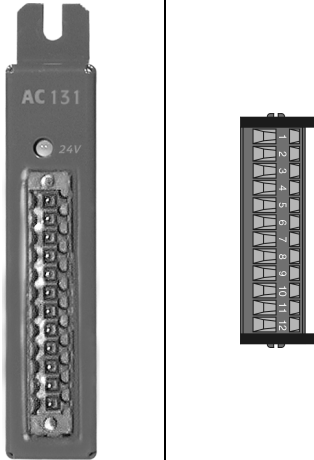
Image	X1	Pin	Description	Function
		1	Analog I 1 +	Analog input 1 plus
		2	Analog I 1 -	Analog input 1 minus
		3	COM (1, 2, 5, 6)	Analog input 0 V
		4	Shield	Shield
		5	Analog I 2 +	Analog input 2 plus
		6	Analog I 2 -	Analog input 2 minus
		7	COM (1, 2, 5, 6)	Analog input 0 V
		8	Shield	Shield
		9	Digital I/O 1	Digital input / output 1
		10	Digital I/O 2	Digital input / output 2
		11	+24V	Supply +24 V
		12	COM (9-11)	Supply 0 V
Terminal Cross Sections		[mm²]	[AWG]	
Solid Core / Multiple Conductor Lines		0.5 - 1.5	20 - 14	
Flexible, Multiple Conductor Line without Wire Tip Sleeves		0.5 - 1.5	20 - 14	
with Wire Tip Sleeves		0.5 - 1.5	20 - 14	
Approbation Data (UL/C-UL-US- and CSA)				
UL/C-UL-US		---	26 - 14	
CSA		---	26 - 14	
Holding Torque for the Terminal Screws [Nm]		0.2 ... 0.25		

Table 92: Pin assignments AC131 - digital mixed module

5.8 Connecting Cables to Plug-in Modules



Figure 39: Connecting Cables to Plug-in Modules

Stress relief for the cable is implemented using a cable tie. The cable tie is to be run through the eye on the bottom of the plug-in module.

Make sure that the ventilation slots on the bottom of the ACOPOS drive are not blocked.

6. Cables

6.1 Motor Cable

6.1.1 Motor Cable Construction

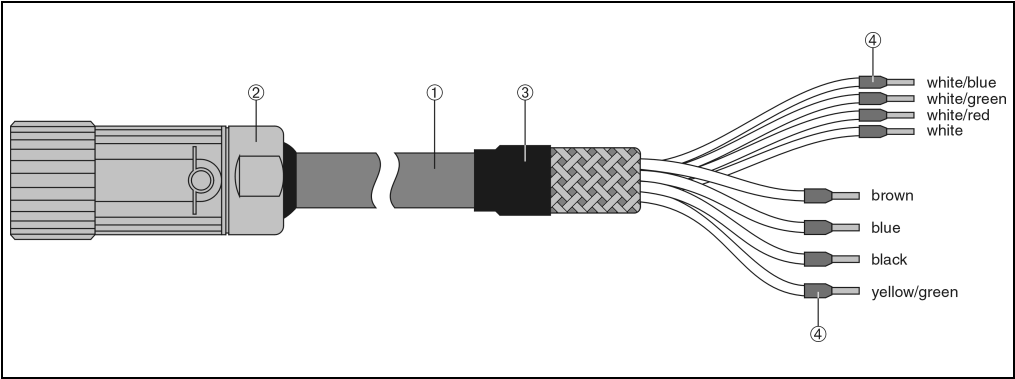
			
Pos.	Amount	Description	Remark
1	1	Motor lines	4 x 1.5 mm² + 2 x 2 x 0.75 mm² 4 x 4 mm² + 2 x 2 x 1 mm² 4 x 10 mm² + 2 x 2 x 1.5 mm² 4 x 35 mm² + 2 x 2 x 1.5 mm² (not prefabricated)
2	1	Circular connector	BSTA 108 FR 19 58 0036 000 (for 8CMxxx.12-1) BSTA 108 FR 35 59 0036 000 (for 8CMxxx.12-3) CSTA 264 FR 48 25 0001 000 (for 8CMxxx.12-5)
3	1	Heat shrink tubing	
4	8	Wire tip sleeve	

Table 93: Motor cable construction

6.1.2 Pin Assignments for 8CMxxx.12-1, 8CMxxx.12-3

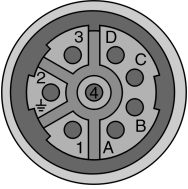
Circular Connector	Pin	Description	Function
	1	U	Motor connection U
	4	V	Motor connection V
	3	W	Motor connection W
	2	PE	Protective ground conductor
	A	T+	Temperature +
	B	T-	Temperature -
	C	B+	Brake +
	D	B-	Brake -

Table 94: Pin assignments for motor cable 8CMxxx.12-1, 8CMxxx.12-3

6.1.3 Cable Schematic for 8CMxxx.12-1, 8CMxxx.12-3

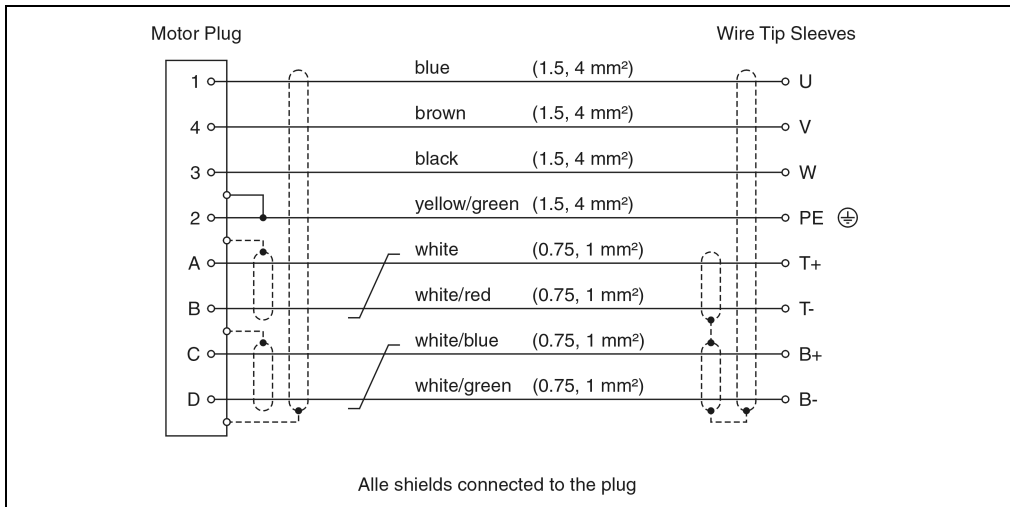


Figure 40: Cable schematic for motor cable 8CMxxx.12-1, 8CMxxx.12-3

6.1.4 Pin Assignments for 8CMxxx.12-5

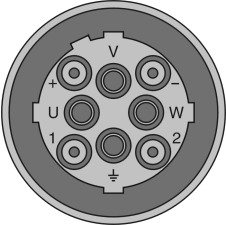
Circular Connector	Pin	Description	Function
	U	U	Motor connection U
	V	V	Motor connection V
	W	W	Motor connection W
	⏏	PE	Protective ground conductor
	1	T+	Temperature +
	2	T-	Temperature -
	+	B+	Brake +
	-	B-	Brake -

Table 95: Pin assignments for motor cables 8CMxxx.12-5

6.1.5 Cable Schematic for 8CMxxx.12-5

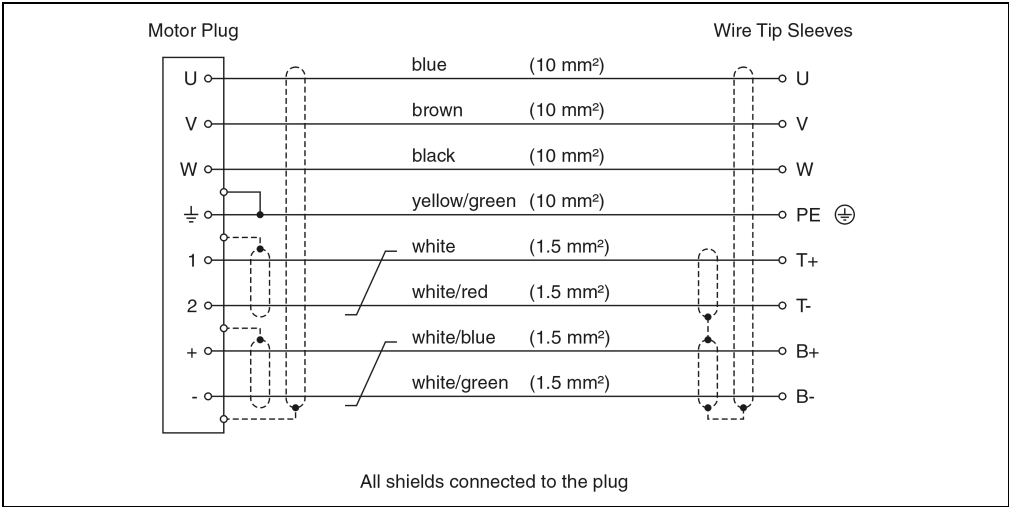


Figure 41: Cable schematic for motor cables 8CMxxx.12-5

6.2 EnDat Encoder Cables

6.2.1 EnDat Encoder Cable Construction

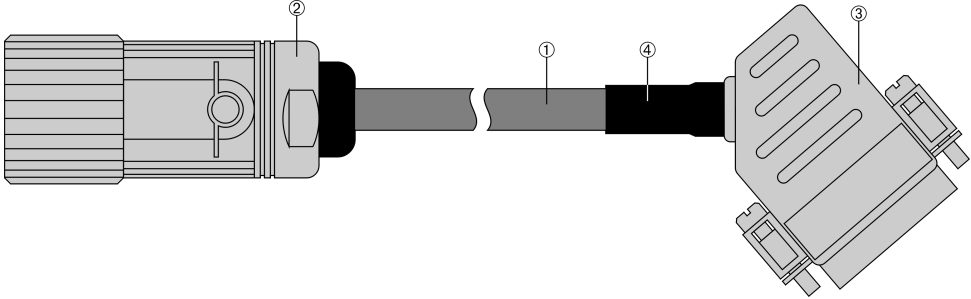
			
Pos.	Amount	Description	Remark
1	1	Encoder cable	10 x 0.14 mm ² + 2 x 0.50 mm ²
2	1	Circular connector, 17 pin socket	ASTA 035 FR 11 12 0035 000
3	1	DSUB housing 45°, metal plated, 15-pin plug	
4	1	Heat shrink tubing	

Table 96: EnDat encoder cable construction

6.2.2 Pin Assignments

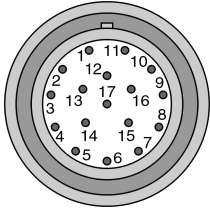
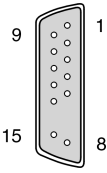
Circular Connector	Pin	Description	Function	Pin	DSUB Plug
	15	A	Channel A	1	
	10	COM (1, 3 - 9, 11, 13 - 15)	Encoder supply 0 V	2	
	12	B	Channel B	3	
	7	+5V out / 0.25A	Encoder supply +5 V	4	
	14	D	Data input	5	
	8	T	Clock output	8	
	16	A\	Channel A inverted	9	
	4	Sense COM	Sense input 0 V	10	
	13	B\	Channel B inverted	11	
	1	Sense +5V	Sense input +5 V	12	
	17	D\	Data inverted	13	
	9	T\	Clock output inverted	15	

Table 97: Pin assignments for EnDat encoder cables

6.2.3 Cable Schematic

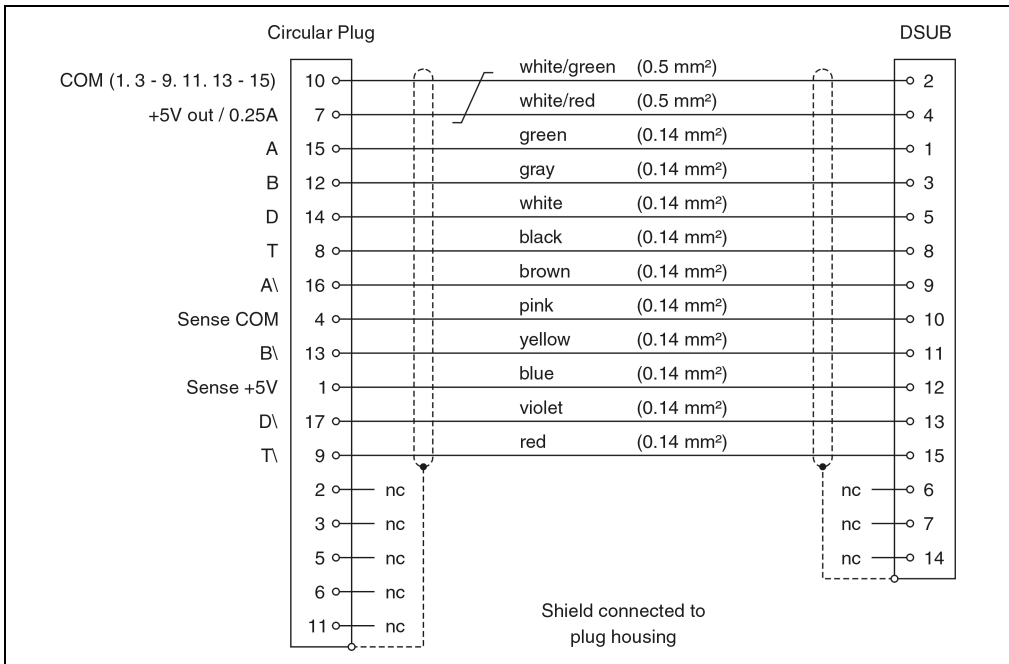


Figure 42: Cable schematic for EnDat encoder cables

6.3 Resolver Cables

6.3.1 Resolver Cable Construction

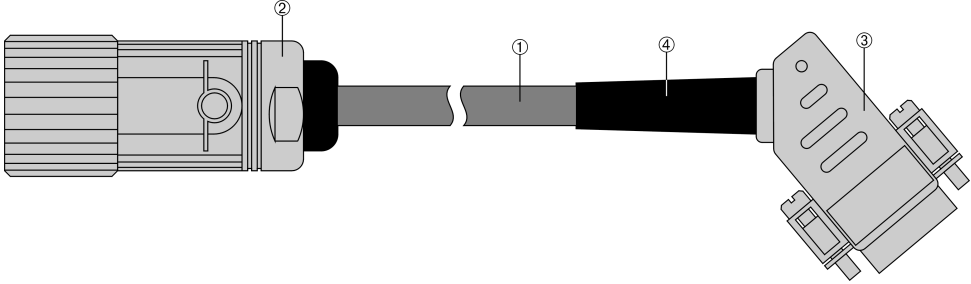
			
Pos.	Amount	Description	Remark
1	1	Encoder cable	3 x 2 x 24 AWG/19
2	1	Circular connector, 12 pin socket	ASTA 021 FR 11 10 0035 000
3	1	DSUB housing 45°, metal plated, 9 pin plug	
4	1	Kink protection	

Table 98: Resolver cable construction

6.3.2 Pin Assignments

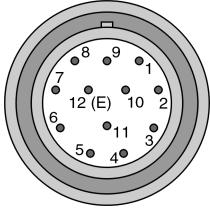
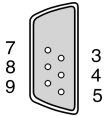
Circular Connector	Pin	Description	Function	Pin	DSUB Plug
	1	---			
	2	---			
	3	Cos	Cosine input	3	
	4	Sin	Sine input	4	
	5	Ref	Reference output	5	
	6	---			
	7	Cos\	Cosine input inverted	7	
	8	Sin\	Sine input inverted	8	
	9	Ref \	Reference output inverted	9	
	10	---			
	11	---			
	12	---			

Table 99: Pin assignments for resolver cable

6.3.3 Cable Schematic

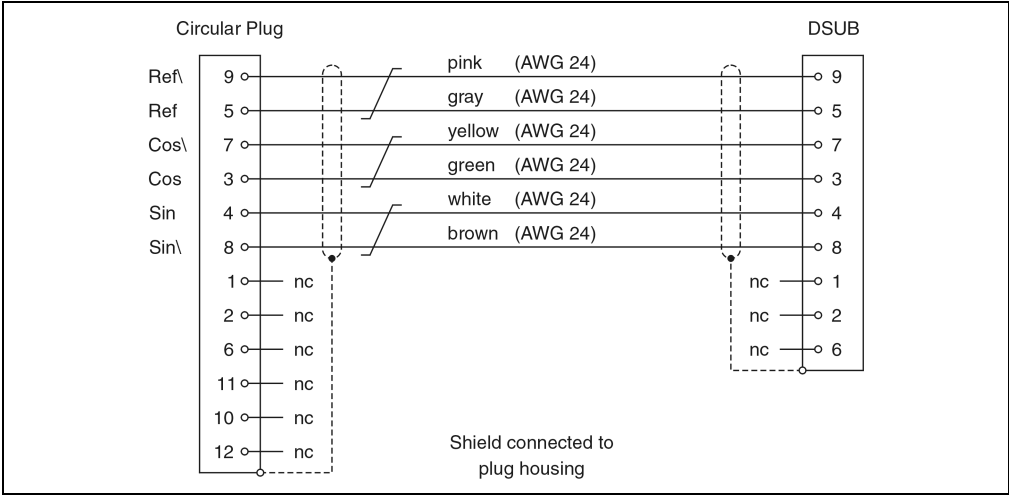


Figure 43: Cable schematic for resolver cables

Chapter 6 • Getting Started

1. Preparation

1.1 Unpacking the ACOPOS Servo Drive

Remove the protective packaging from the ACOPOS servo drive. Check the ACOPOS servo drive for obvious mechanical damage.

Danger!

Do not operate the ACOPOS servo drive if it is damaged. This can cause severe personal injury or damage to property!

1.2 Installing and Connecting the ACOPOS Servo Drive

The guidelines and specifications for installing and wiring the respective ACOPOS servo drive can be found in chapter 3 "Installation", chapter 4 "Dimensioning" and chapter 5 "Wiring".

1.3 Connecting the ACOPOS Servo Drive with a B&R PLC

Depending on the configuration, ACOPOS servo drives are equipped with a CAN (AC110) or ETHERNET Powerlink (AC112) interface which can be used to connect to a B&R PLC. The connection is made using a a CAN cable (AC110) or an Ethernet cable ¹⁾ (AC112) (pin assignments can be found in chapter 5 "Wiring" and in the User's Manual for the PLC).

1) Caution: In general, crossover Ethernet cables must be used for ETHERNET Powerlink connections!

2. Starting Up an ACOPOS Servo Drive

The goal of the following example is move the shaft of a motor connected to an ACOPOS servo drive 5000 units. In order to emphasize the important points of starting up the hardware, this will be done using an sample project contained in B&R Automation Studio™.

Danger!

Incorrect control of motors or mechanical parts connected to the motor shaft can cause unwanted and dangerous movements!

2.1 General Information

The start-up procedure described here is based on the following configuration: ¹⁾

Model number	Short description
Servo Drives	
8V1045.00-1	Servo drive 3 x 400-480V 4.4A 2kW, line filter and braking resistor integrated
Plug-in Modules	
8AC110.60-1	ACOPOS plug-in module, CAN interface
8AC120.60-1	ACOPOS plug-in module, EnDat encoder interface
Motor	
8MSA4L.E0-B4	Motor MSA4 series with EnDat encoder
Accessories	
7AC911.9	Bus connector, CAN (2 pcs.)
8CE005.12-1	EnDat cable, length 5m, 10 x 0.14mm ² + 2 x 0.5mm ² , EnDat connector 17-pin Intercontec socket, servo connector 15-pin DSUB plug, can be used in cable drag chains, UL/CSA listed
8CM005.12-1	Motor cable, length 5m, 4 x 1.5mm ² + 2 x 2 x 0.75mm ² , motor connector 8 pin Intercontec socket, can be used in cable drag chains, UL/CSA listed
0G0001.00-090	Cable PC <--> PLC/PW, RS232, Online cable
PLC CPU	
7CP476.60-1	2003 CPU, 750 KB SRAM, 1.5 MB FlashPROM, 24 VDC, 12.5 W supply, 1 RS232 interface, 1 CAN interface, CAN: electrically isolated, network capable, 4 slots for screw-in modules, system bus for expansion modules, max. 272 digital / 80 analog I/O points
B&R Automation Studio™	
1A4000.Lx	B&R AutomationSoftware™ CD, full version

Table 100: Configuration for the start-up example

¹⁾ The procedure can change slightly depending on the hardware configuration. The procedure does **not** change using an 8V1045.00-2.

The hardware configuration will be called the "target system" in the following sections. A PC with B&R Automation Studio™ installed will also be needed.

2.1.1 Sample project

Several sample projects are available in B&R Automation Studio™ which can be used to test ACOPOS servo drives. They are found in the directory "...\\BR_AS_XXX\\SAMPLES\\MOTION" in the B&R Automation Studio™ installation directory (xxx indicates the B&R Automation Studio™ version number).

"...\\BR_AS_XXX\\SAMPLES\\MOTION\\DEUTSCH\\ACP10\\CAN\\M68K\\C\\ACP10.PGP\\ACP10.GDM" is the sample project referred to in this section, starting with ACOPOS operating system version V 0.472 (xxx indicates the B&R Automation Studio™ version number).

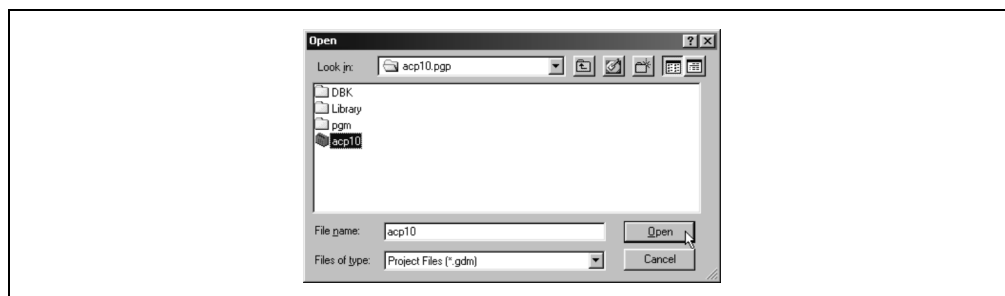


Figure 44: Open sample project

Information:

During start-up, changes will be made to the sample project. We recommend that you make a copy of the sample project (entire ACP10.PGP directory, see figure 44 "Open sample project") in a different project directory and use it for the start-up.

2.1.2 Preparing the Hardware for Sample Project acp10.gdm

- Check the wiring of the ACOPOS servo drive connections (also see chapter 5 "Wiring").
- Set node number 1 on the AC110 plug-in module (see chapter 2 "Technical Data").
- Connect the PC with the PLC using the online cable (see user's manual for the PLC for information concerning the online cable connection to the PLC).
- Apply power to the PLC and the ACOPOS servo drive (24 VDC, 400 VAC). You can make sure the ACOPOS servo drive boots correctly by watching the blink code (see chapter 2 "Technical Data").

2.2 Start-Up

2.2.1 Load Sample Project

Start B&R Automation Studio™:

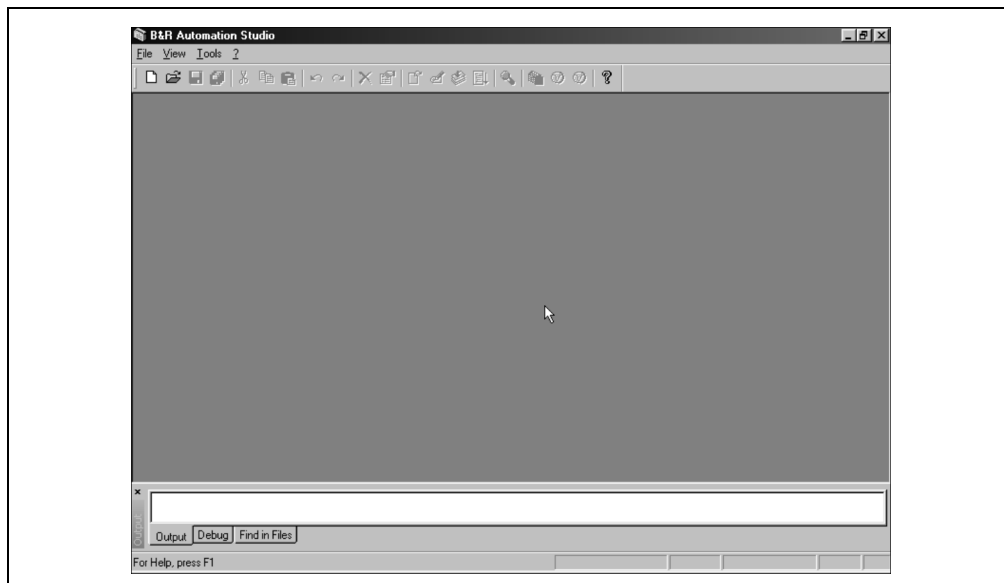


Figure 45: B&R Automation Studio™ Start-up Screen

Open the project (recommended: make a copy of sample project ACP10.GDM in the respective project path):

- Click **Open Project ...** in the **File** menu.

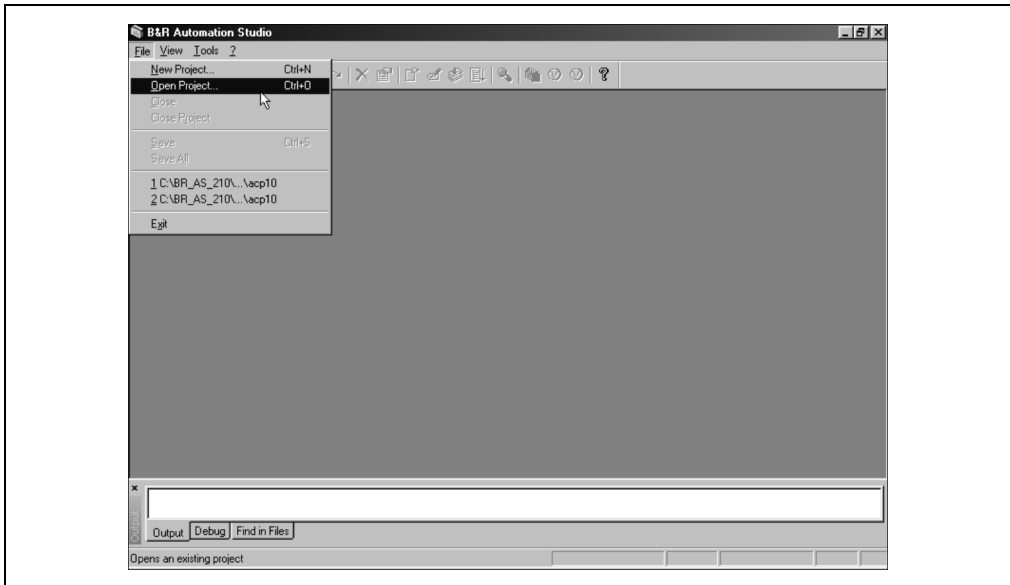


Figure 46: Open project

- Select ...\\ACP10.PGP\\ACP10.GDM.
- Load the project by clicking on the **Open** button.

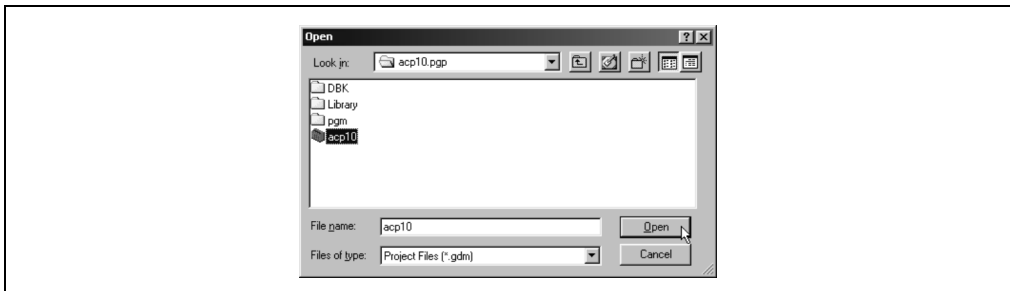


Figure 47: Selecting the project

The selected project is then opened in the project window:

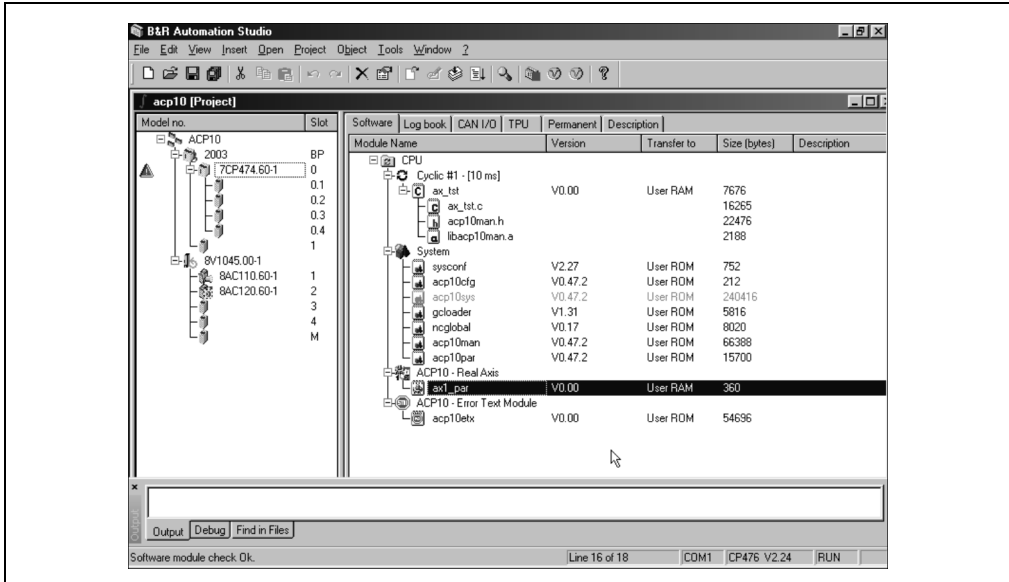


Figure 48: Project window with representation of the hardware and software configuration

The left part of the window contains the hardware configuration for the project and the right part of the window contains the software configuration for the hardware component selected in the left part of the window.

Information:

When loading the project, a connection is automatically established between the PC and the PLC.

If the connection is active, the CPU type and "RUN" are shown to the right below the status bar (see figure 48 "Project window with representation of the hardware and software configuration").

2.2.2 Preset Values for the Sample Project

A few preset values must be defined on the target system before downloading the project.

CPU

The sample project was originally created for a different PLC CPU (7CP474.60-1).

This must be changed to the CPU used on the target system (shown to the right under the status bar):

- In the left part of the window, position the mouse pointer on the CPU (7CP474.60-1).

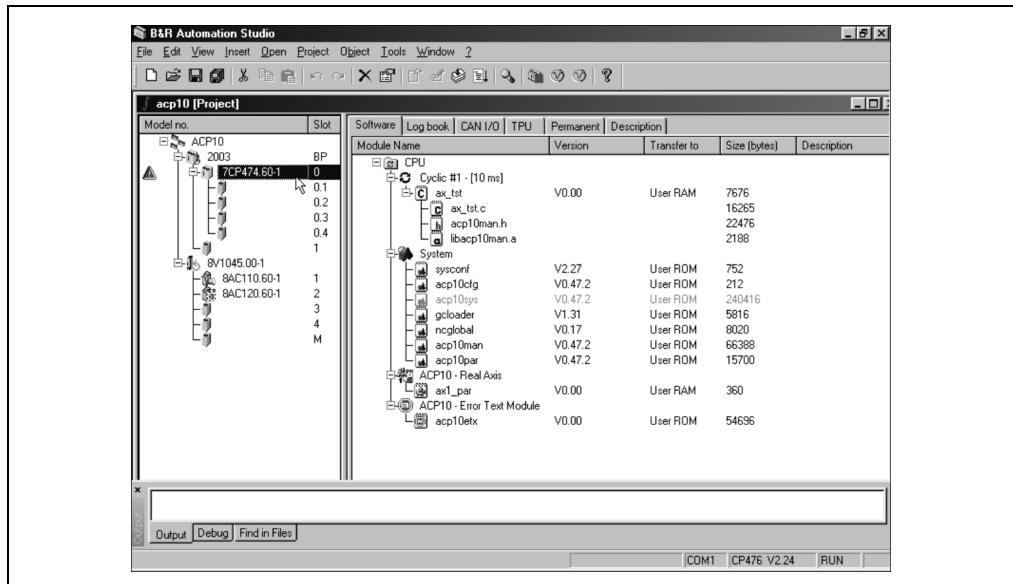


Figure 49: Select the CPU in the left part of the window

- Open the shortcut menu with the right mouse button.
- Position the mouse pointer on **Replace with 7CP476.60-1**.
- Select this menu item with the left mouse button.

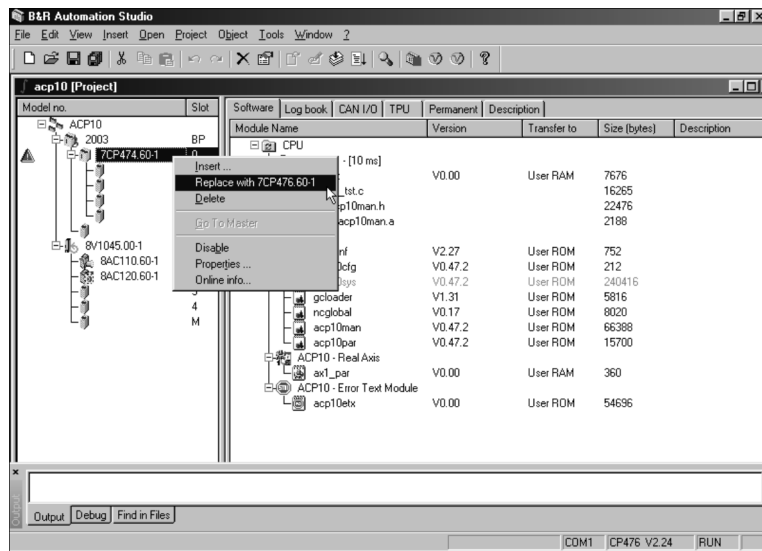


Figure 50: Select the command used to replace the CPU from the shortcut menu

- Acknowledge the change of the CPU by clicking on the **OK** button.

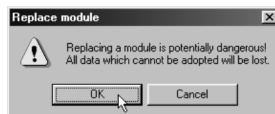


Figure 51: Acknowledge the change of the CPU

User Memory

Before downloading the sample project, we recommend clearing the user memory on the PLC:

- In the **Project** menu, select **Services** and then **Clear Memory**

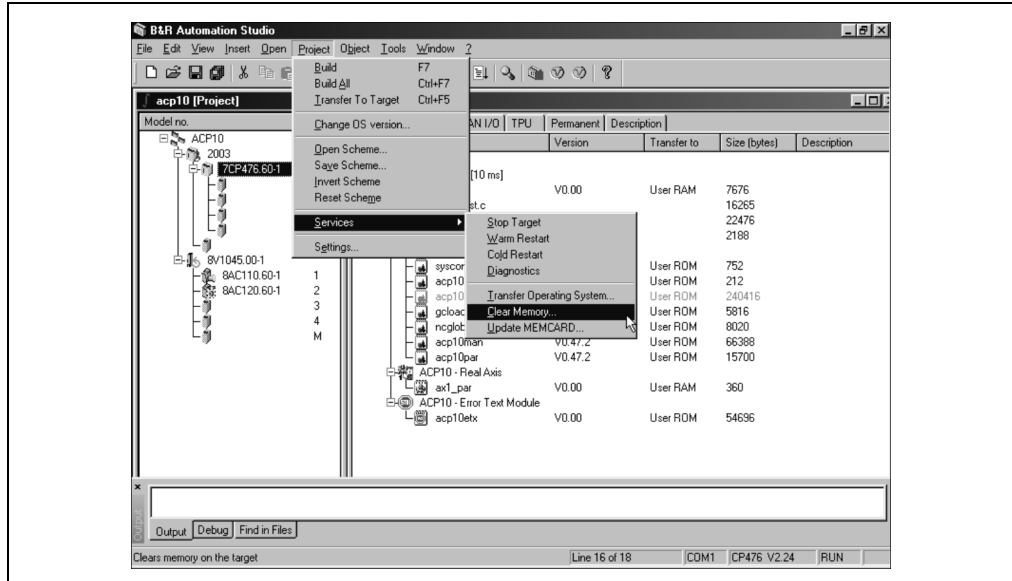


Figure 52: Clearing user memory on the PLC

- Activate the checkbox **Erase USER ROM**.
- Acknowledge the selection by clicking the **OK** button.

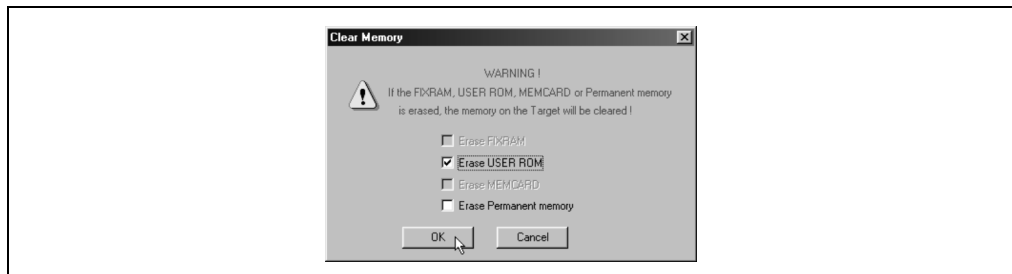


Figure 53: Selecting the user memory on the PLC

- The user memory is erased.



Figure 54: Erasing the user memory

After clearing the user memory, the project window will be shown again.

Operating System Download

The first time an ACOPOS servo drive is started up, the ACOPOS operating system ACP10SYS must also be transferred to the target system. In the sample project, transferring ACP10SYS is deactivated (shown in gray in the right part of the window). Transferring ACP10SYS must be activated separately in the sample project:

- Position the mouse pointer on ACP10SYS in the right part of the window.

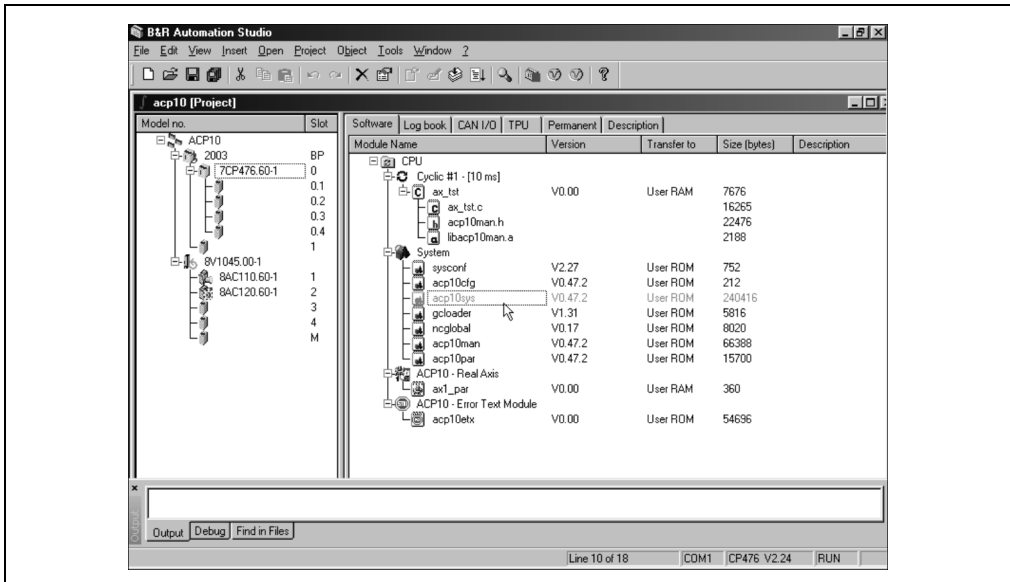


Figure 55: Place mouse pointer on ACOPOS operating system ACP10SYS

- Open the shortcut menu with the right mouse button.
- Position the mouse pointer on **Disable**.
- Click on **Disable** with the left mouse button to cancel deactivation.

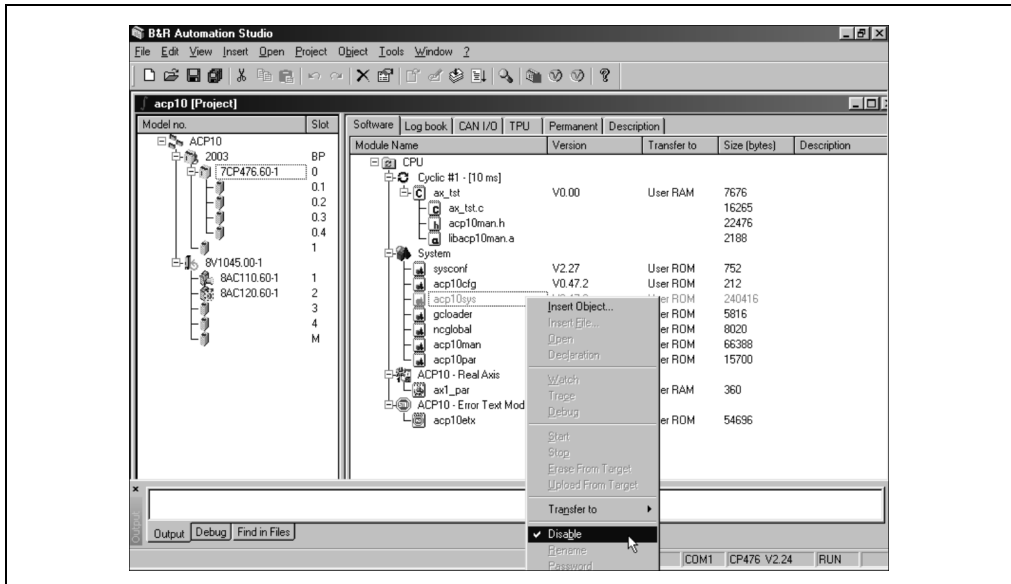


Figure 56: Enable transferring the ACOPOS operating system

ACP10SYS is now enabled (shown in black instead of gray) and is also transferred the next time the project is downloaded.

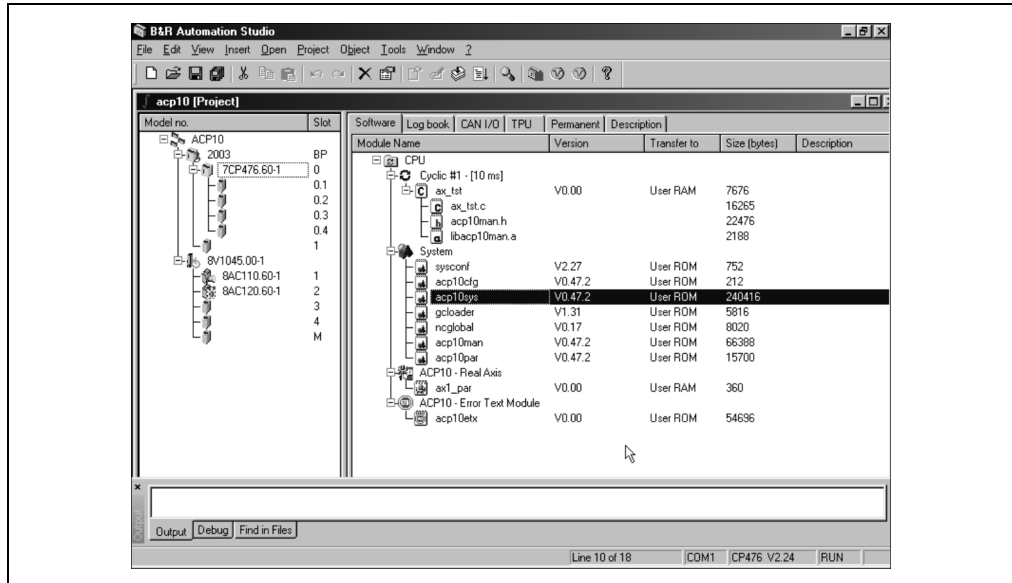


Figure 57: The operating system is also transferred the next time the project is downloaded

Information:

After successfully downloading the operating system the first time, "Disable" can be set again which shortens the download time for projects.

2.2.3 Preset Values Concerning Wiring

The further procedure depends on the wiring of the digital control inputs on the ACOPOS servo drives.

End Switch and Quickstop are Wired

If the hardware end switches (normally closed) are wired to X1 / End+ and X1 / End- and a quickstop switch (normally closed) is wired to X1 / Quickstop/Trigger2 according to section 2 "Pin Assignments ACOPOS 1022, 1045, 1090", on page 139, then start-up can be continued with section 2.2.4 "Downloading the Project", on page 188.

End Switch and Quickstop are not Wired

If the hardware end switches and quickstop are not wired, it is possible to change the parameters so that the motor shaft can still be moved.

Danger!

When moving the motor shaft without the hardware end switches connected, movements of mechanical parts mounted on the motor shaft must be considered. Otherwise severe personal injury or damage to property can occur!

- Position the cursor on the initial parameter module AX1_PAR.
- Open the object by double-clicking with the left mouse button.

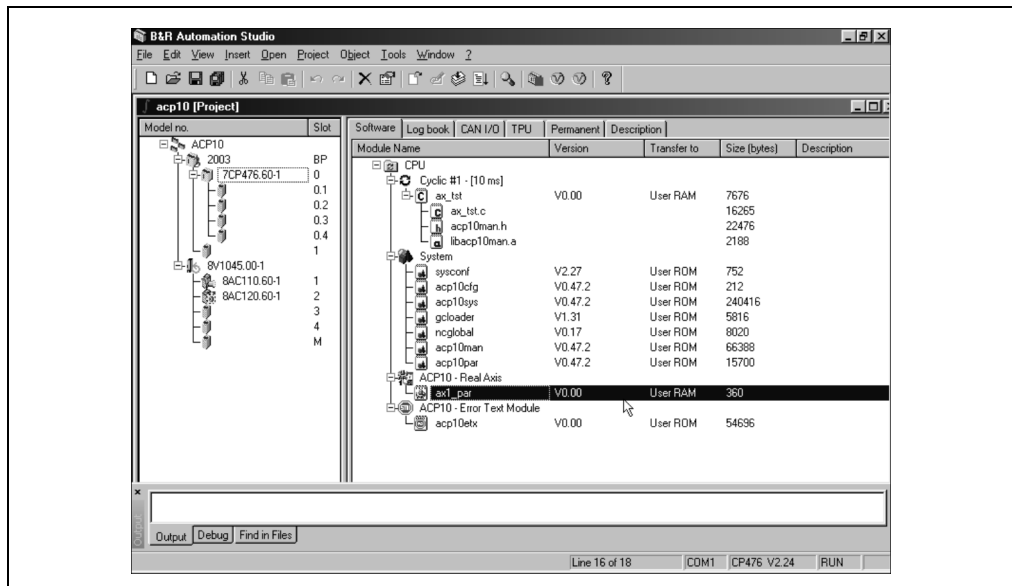


Figure 58: Open initial parameter module AX1_PAR

- Position the mouse pointer on "dig_in".

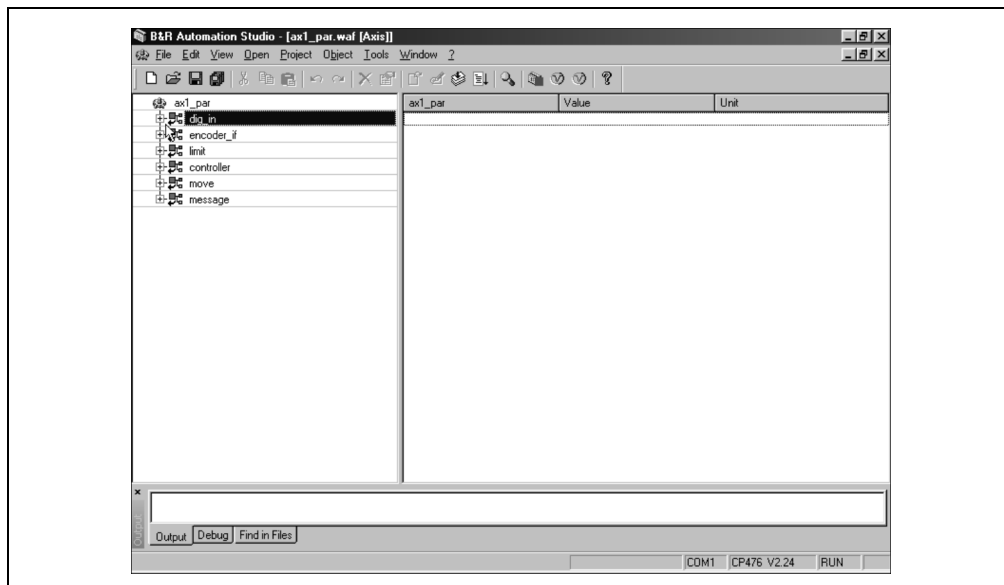


Figure 59: Place the mouse pointer on "dig_in"

- Expand the view by clicking on "+".

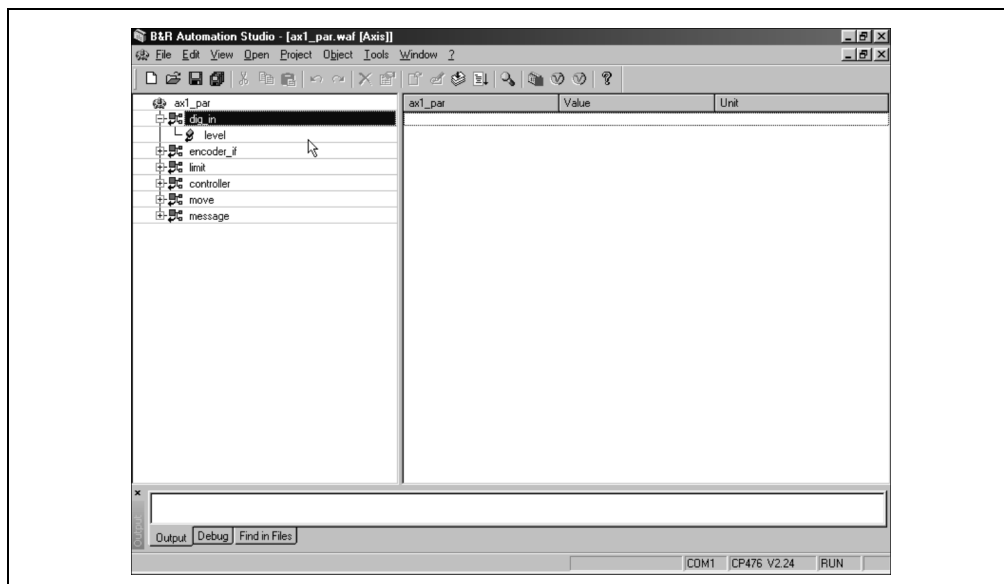


Figure 60: Expand the view

- Position the mouse pointer on "level". The parameters are now shown in the right part of the window.

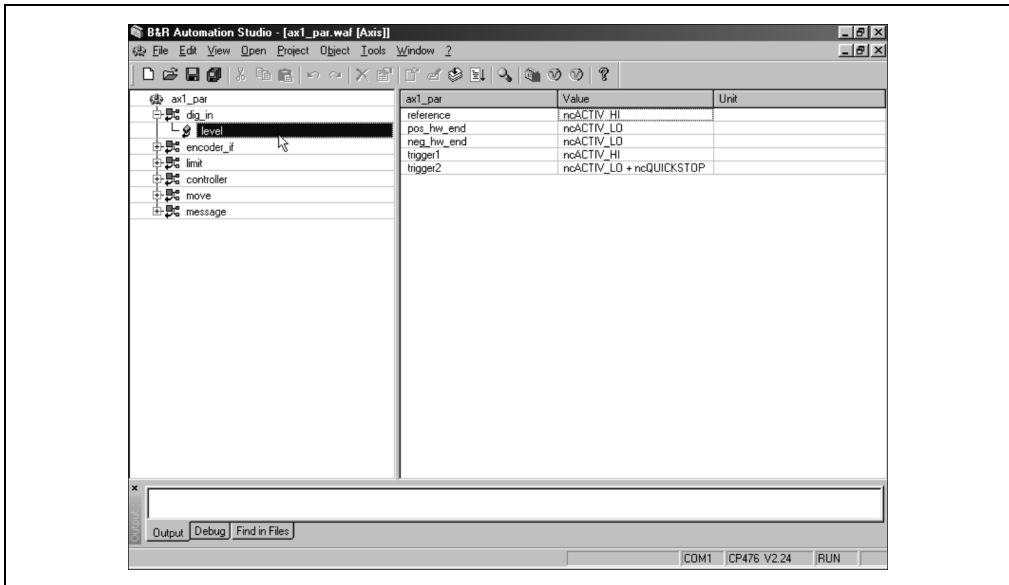


Figure 61: Displaying the level parameters

To allow movement of the motor shaft, the following parameters must be changed to the value "ncACTIV_HI":

- pos_hw_end
- neg_hw_end
- trigger2 (quickstop)

"ncACTIV_HI" means that the inputs for both hardware end switches and the quickstop are activated (logical "1"). This allows the motor shaft to be moved without wiring the hardware end switches and a quickstop.

The procedure is shown here in an example for pos_hw_end:

- In the right part of the window, position the mouse pointer on level "ncACTIV_LO" for the shaft parameter pos_hw_end.

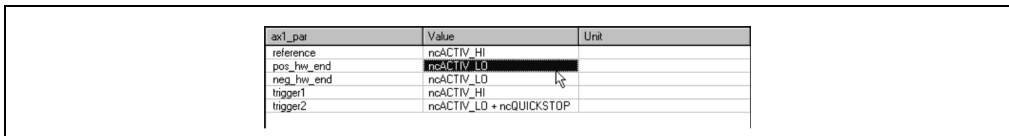


Figure 62: Place mouse pointer on level "ncACTIV_LO"

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- Open the selection list by clicking with the left mouse button.
- Select "ncACTIV_HI" by clicking with the left mouse button.

ax1_par	Value	Unit
reference	ncACTIV_HI	
pos_hw_end	ncACTIV_LO	
neg_hw_end	ncACTIV_LO	
trigger1	ncACTIV_LO + ncFORCE	
trigger2	ncACTIV_LO	
	ncACTIV_HI	
	ncACTIV_HI + ncFORCE	
	ncACTIV_HI + ncQUICKSTOP	
	ncACTIV_HI + ncFORCE + ncQU	
	ncACTIV_LO + ncQUICKSTOP	
	ncACTIV_LO + ncFORCE + ncQU	

Figure 63: Change the level for the positive hardware end switch

- Acknowledge the selection by pressing the ENTER key.

ax1_par	Value	Unit
reference	ncACTIV_HI	
pos_hw_end	ncACTIV_HI	
neg_hw_end	ncACTIV_LO	
trigger1	ncACTIV_HI	
trigger2	ncACTIV_LO + ncQUICKSTOP	

Figure 64: Acknowledge level change

Use the same procedure for the other two parameters, neg_hw_end and trigger2 (quickstop).

When all changes are made, the value list looks like this:

ax1_par	Value	Unit
reference	ncACTIV_HI	
pos_hw_end	ncACTIV_HI	
neg_hw_end	ncACTIV_HI	
trigger1	ncACTIV_HI	
trigger2	ncACTIV_HI	

Figure 65: Levels after all changes are made

Now the object window can be closed.

- In the **File** menu, click on **Close**.

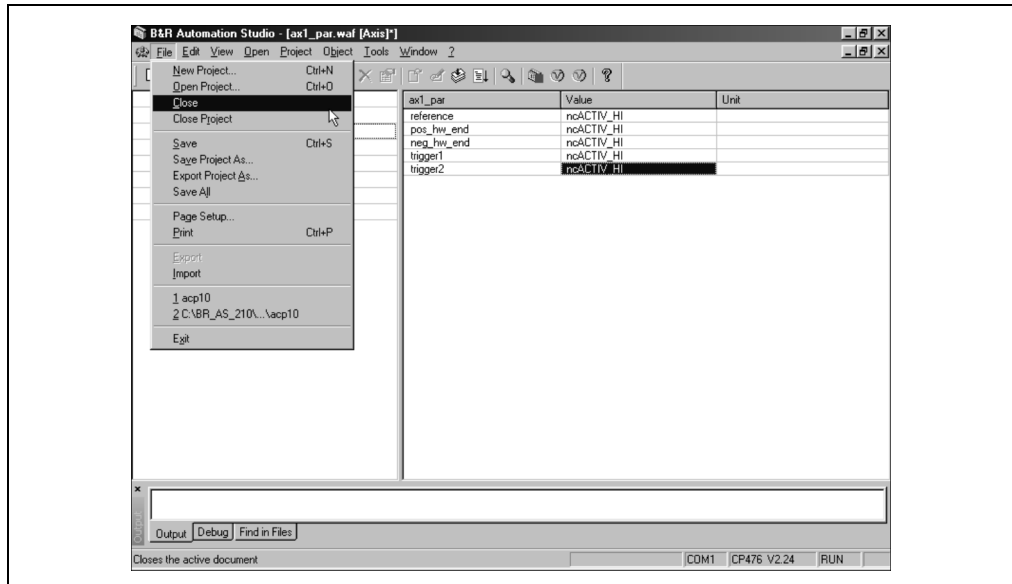


Figure 66: Closing the object window

- Acknowledge the changes by clicking the **Yes** button.

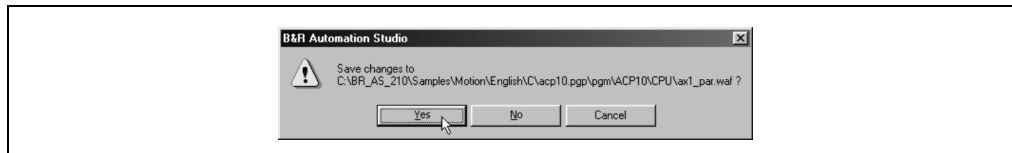


Figure 67: Acknowledge level changes

The project window will be shown again.

2.2.4 Downloading the Project

After making the preparations, the project can now be transferred to the target system:

- In the **Project** menu, click on **Transfer To Target**.

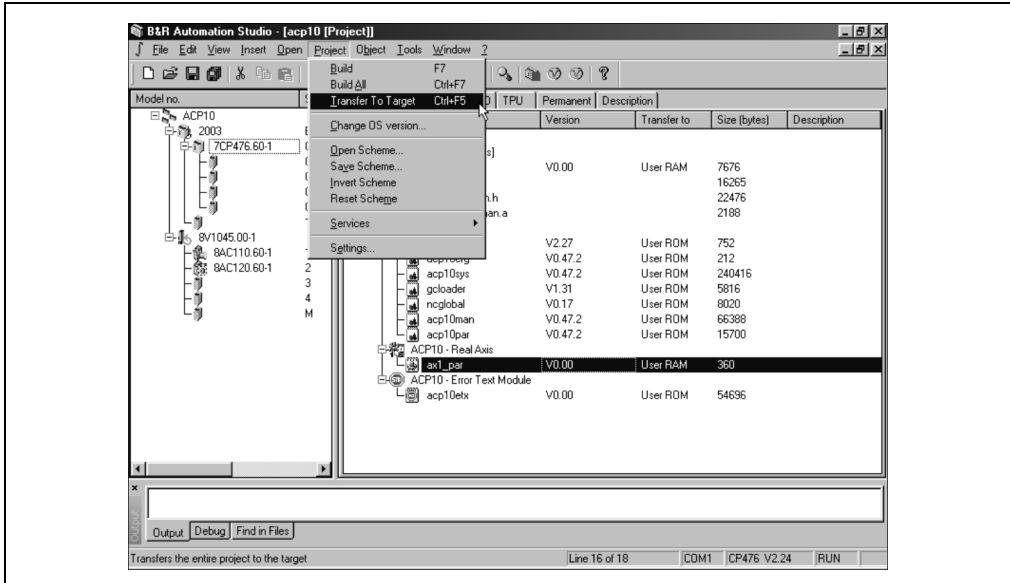


Figure 68: Click on the command to transfer the project to the target system

If an operating system has already been transferred to the PLC, a version conflict could occur.

In this case, the operating system on the PLC is to be replaced by the operating system in the sample project:

- Select **Replace operating system ...** option field.

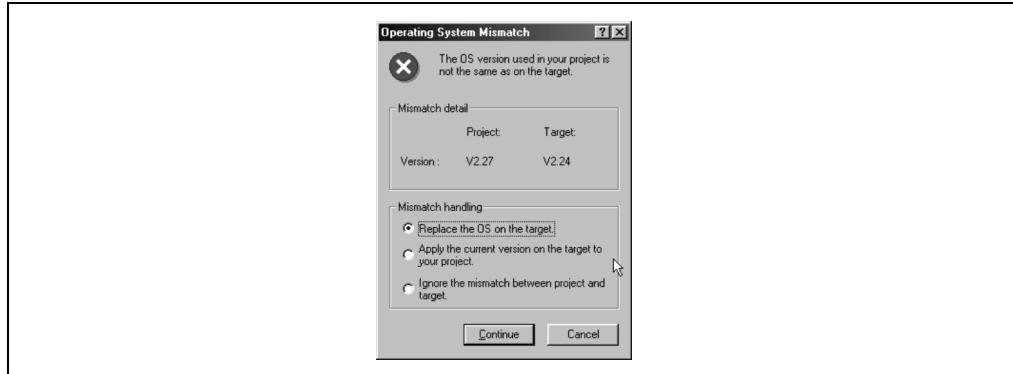


Figure 69: Operating system version conflict

- Acknowledge by clicking the **Continue** button.



Figure 70: Acknowledge selection of conflict resolution

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- A message will be displayed by B&R Automation Studio™. Acknowledge this message by clicking **Yes**.

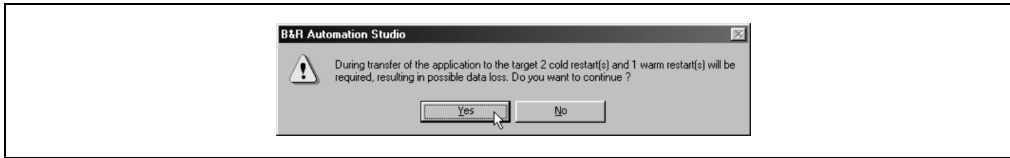


Figure 71: Acknowledge message from B&R Automation Studio™ with **Yes**

- The project is transferred.

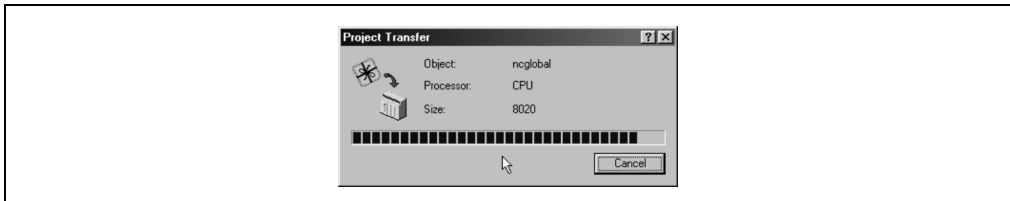


Figure 72: The project is transferred

- The following message is given after the project has been successfully transferred:

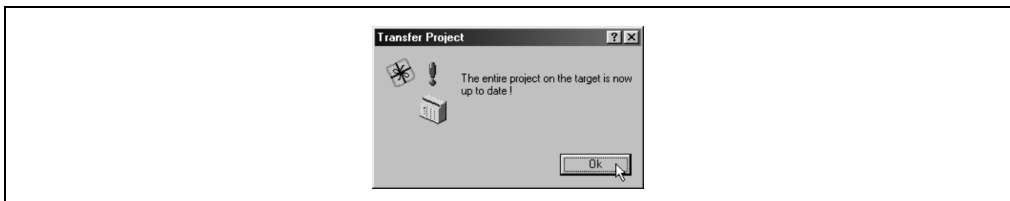


Figure 73: The project was transferred successfully

- Acknowledge the message by clicking the **OK** button.

2.2.5 Test Function

Now control of the motor shaft can be taken over using the test function (ACP10 - real axis):

- Position the cursor on the initial parameter module AX1_PAR.

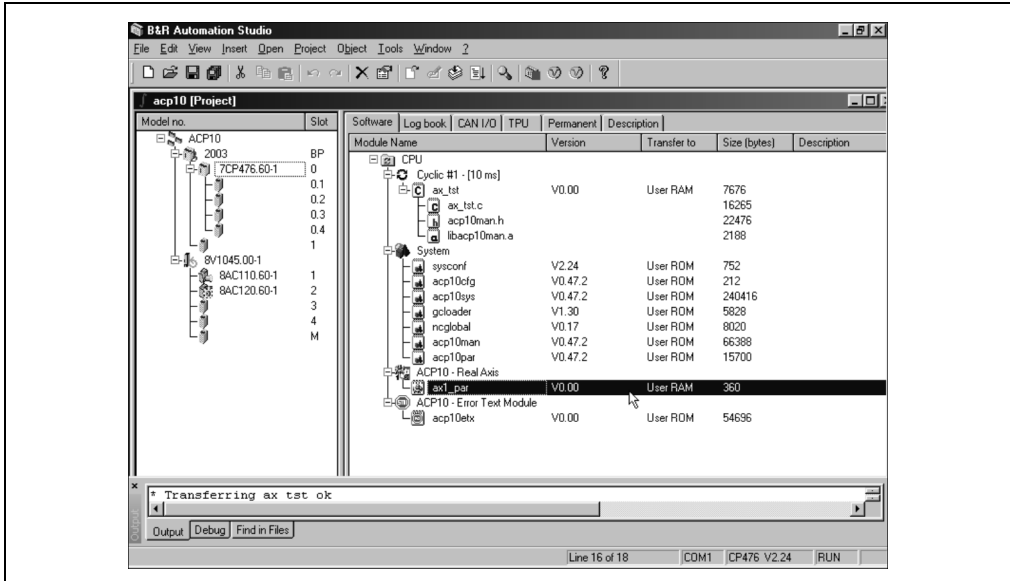


Figure 74: Select initial parameter module AX1_PAR

- In the **Open** menu, click on **Test**.

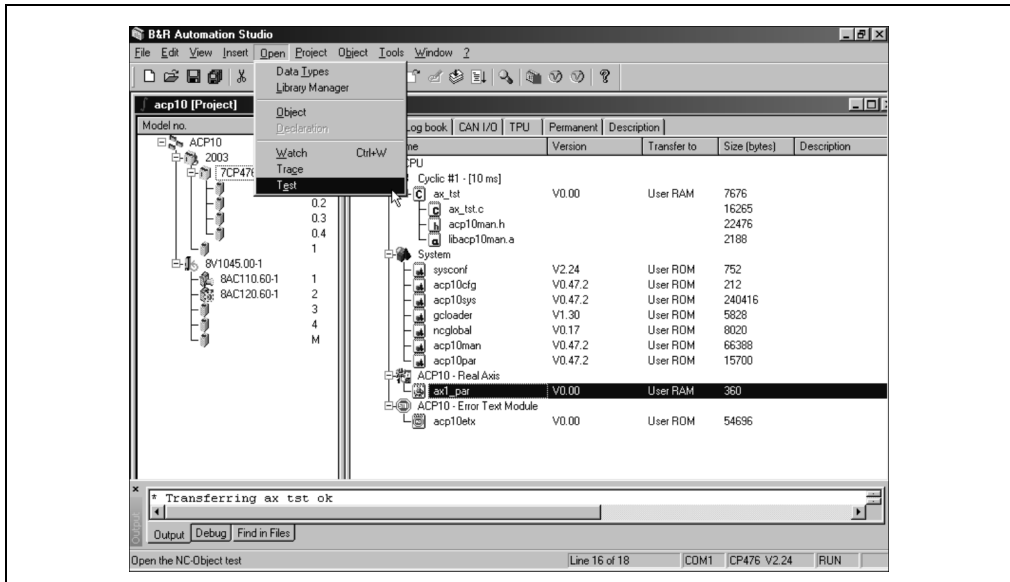


Figure 75: Command to open the test window

The test window is shown:

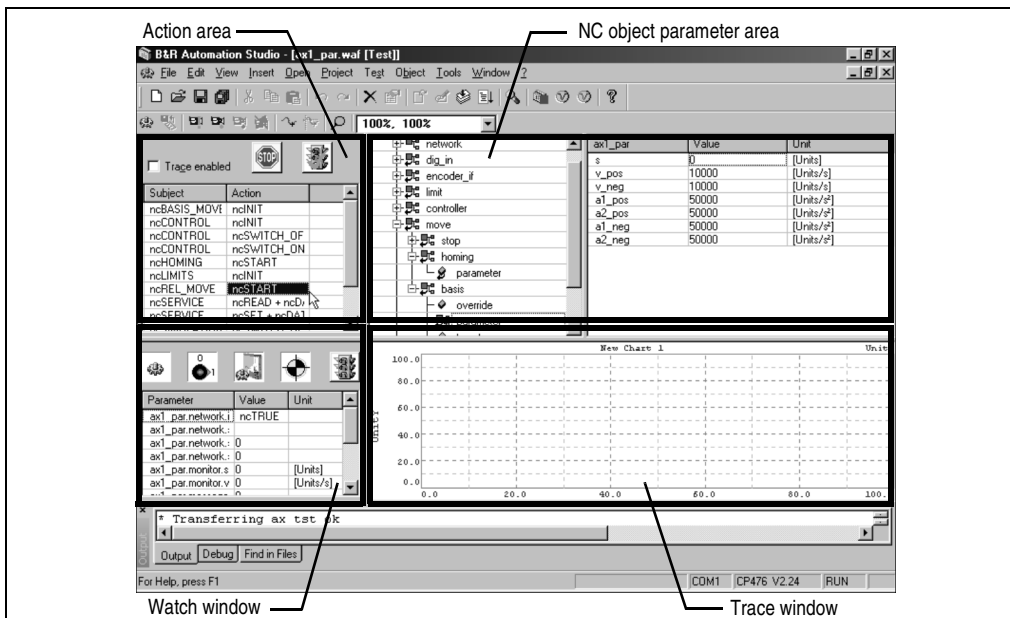


Figure 76: Test window for ACOPOS servo drives

2.2.6 Starting the Motor Movement

Danger!

The traverse path must be adjusted for the conditions present (installed mechanical parts, etc.).

Incorrect control of motors or mechanical parts connected to the motor shaft can cause unwanted and dangerous movements. This can cause severe personal injury or damage to property!

If mechanical parts are mounted on the motor, the number of encoder units per motor revolution must be adjusted to the mechanical characteristics (possible traverse path, etc.).

The number of encoder units per motor revolution (units, rev_motor) can be set as follows:

- Position the mouse pointer on "encoder_if"
- Expand the view by clicking on "+"
- Position the mouse pointer on "parameter"
- Expand the view by clicking on "+"
- Position the mouse pointer on "scaling"
- Expand the view by clicking on "+"
- Position the mouse pointer on "load"

The parameters are now shown in the right part of the window:

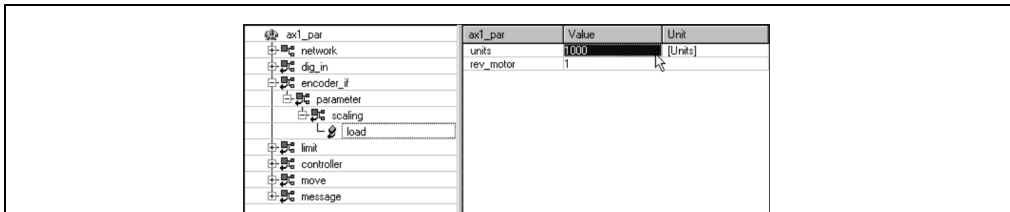


Figure 77: Setting the encoder resolution

Now the values can be adjusted to the mechanical parts used and acknowledged by pressing the ENTER key.

The new encoder parameters now have to be initialized:

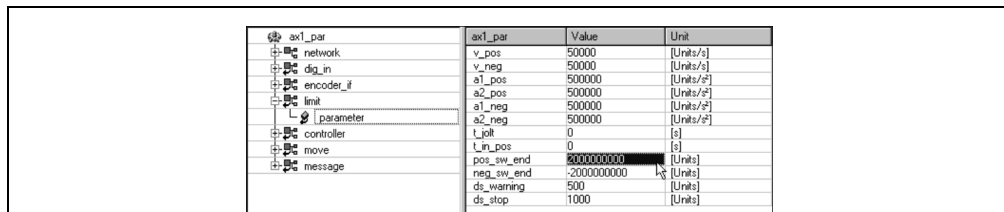
- Action window:
Position the mouse pointer on the action ncENCODER_IF, ncINIT
- Initialize the new values on the encoder by pressing the  button.

For additional safety, the traverse path can be limited using software end switches (pos_sw_end, neg_sw_end).

The software end switches can be defined as follows:

- Position the mouse pointer on "limit"
- Expand the view by clicking on "+"
- Position the mouse pointer on "parameter"

The parameters are now shown in the right part of the window:



ax1_par	Value	Unit
v_pos	50000	[Units/s]
v_neg	50000	[Units/s]
a1_pos	500000	[Units/s²]
a2_pos	500000	[Units/s²]
a1_neg	500000	[Units/s²]
a2_neg	500000	[Units/s²]
L_pos	0	[s]
L_in_pos	0	[s]
pos_sw_end	2000000000	[Units]
neg_sw_end	-2000000000	[Units]
ds_warning	500	[Units]
ds_stop	1000	[Units]

Figure 78: Defining the software end switches

Now the values can be adjusted to the mechanical parts used and acknowledged by pressing the ENTER key.

The new limit values now have to be initialized:

- Action window:
Position the mouse pointer on the action ncLIMITS, ncINIT
- Initialize the new limit values by pressing the  button.

Entering the Traverse Path

- Position the mouse pointer on the **action** "ncSTART" for the **subject** "ncREL_MOVE" in the action window.

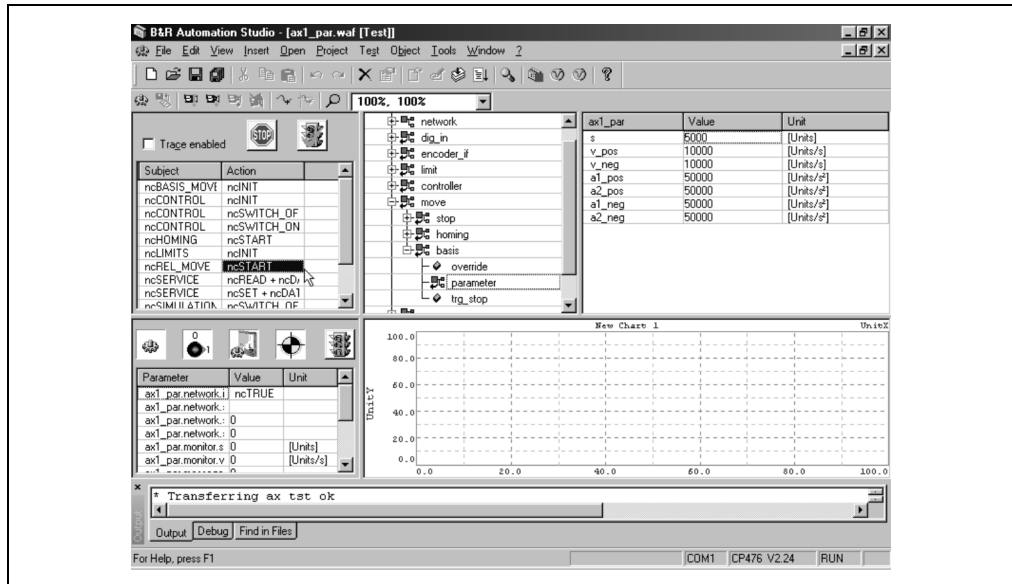


Figure 79: Place mouse pointer on the **action** "ncSTART"

- Enter the value (e.g. 5000) for s (target position or relative traverse path) in the **parameter** object, **value** column.
- Acknowledge by pressing the ENTER key.
The value is entered in the axis data structure.

-
- The screenshot displays the B&R Automation Studio - [ax1_par.wd [Test]] interface. The main workspace shows a ladder logic network with the following components:
- | Subject | Action |
|--------------|---------------|
| ncBASIS_MOVE | ncINIT |
| ncCONTROL | ncINIT |
| ncCONTROL | ncSWITCH_OF |
| ncCONTROL | ncSWITCH_ON |
| ncHOMING | ncSTART |
| ncLIMITS | ncINIT |
| ncREL_MOVE | ncSTART |
| ncSERVICE | ncREAD + ncDI |
| ncSERVICE | ncSET + ncDAI |
| ncSIMULATION | ncSWITCH_OF |
- The network table shows the following connections:
- | ax1_par | Value | Unit |
|---------|-------|-----------|
| s | 5000 | [Units] |
| v_pos | 10000 | [Units/s] |
| v_neg | 10000 | [Units/s] |
| a1_pos | 50000 | [Units/°] |
| a2_pos | 50000 | [Units/°] |
| a1_neg | 50000 | [Units/°] |
| a2_neg | 50000 | [Units/°] |
- The parameter table shows the following values:
- | Parameter | Value | Unit |
|-------------------|--------|-----------|
| ax1_par.network.i | ncTRUE | |
| ax1_par.network.s | 0 | |
| ax1_par.network.v | 0 | |
| ax1_par.monitor.s | 0 | [Units] |
| ax1_par.monitor.v | 0 | [Units/s] |
- The status window at the bottom shows the message: "Transferring ax tst ok". The output window is empty. The bottom status bar indicates the current state: COM1, CP475 V2.24, RUN.

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Start the Motor Movement

- Position the mouse pointer on the **action** "ncSTART" for the **subject** "ncREL_MOVE" in the action window.

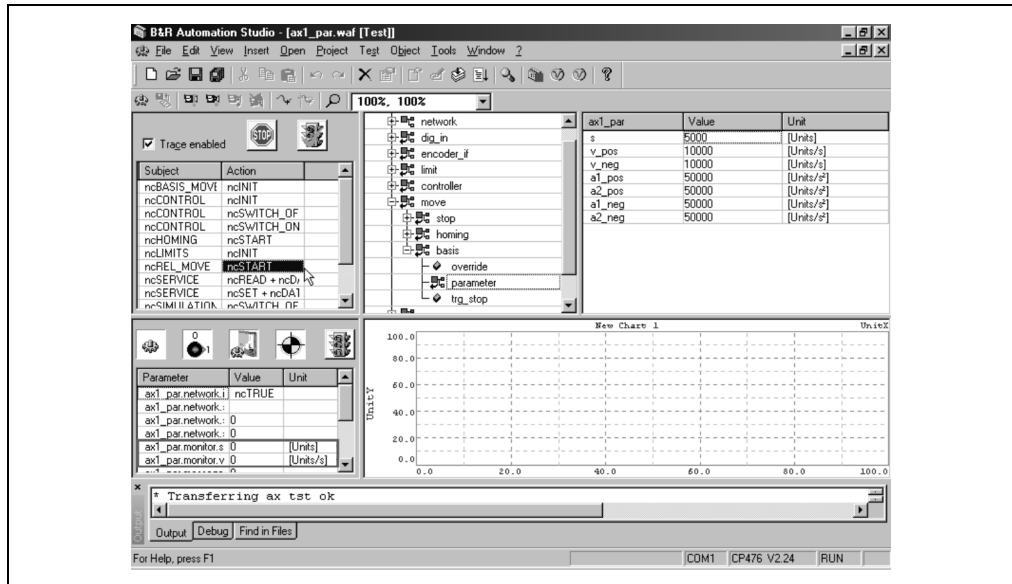


Figure 81: Place mouse pointer on the **action** "ncSTART"

- Click on the  button on the toolbar:

The motor shaft now moves according to the traverse path (s) defined and the Trace function starts.

Display and Evaluation of the Trace Function

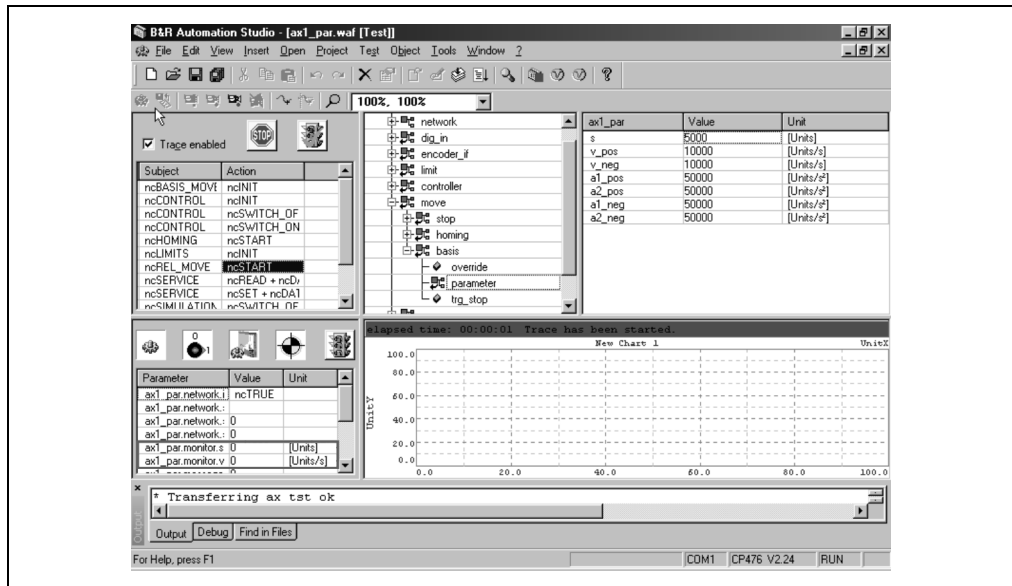


Figure 82: During the movement of the shaft, the traverse path already completed is shown in the Watch window

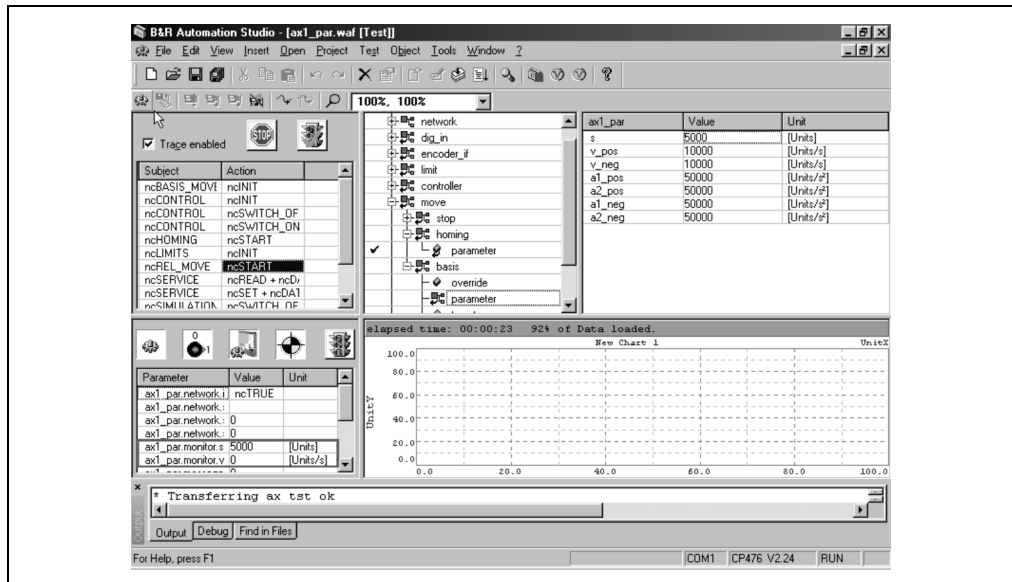


Figure 83: The defined traverse path was completed and the Trace data is loaded

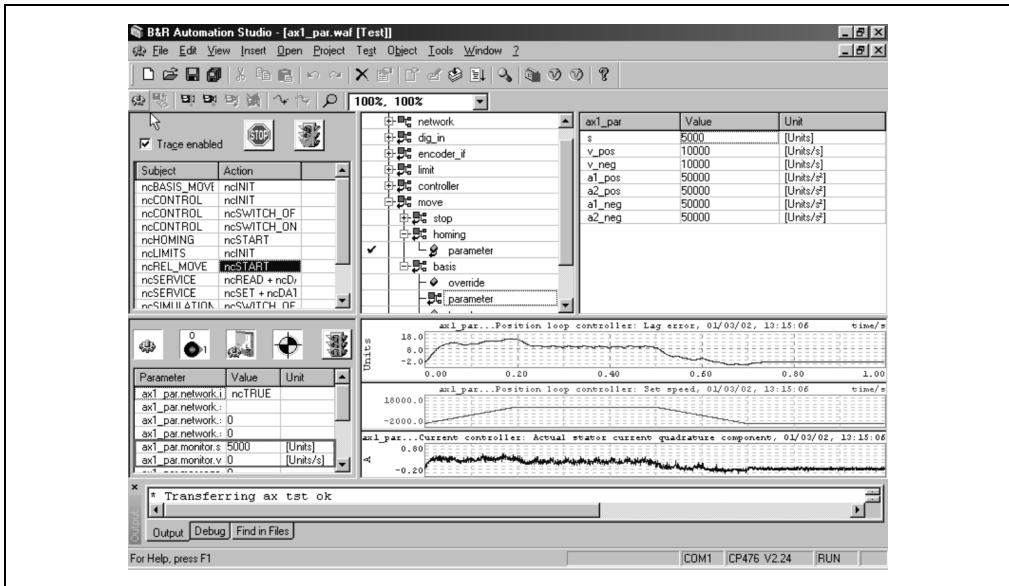


Figure 84: The data recorded is shown in the Trace window

The current position of the motor shaft is shown in the Watch window:

Display of the current position of the motor shaft		
Before the shaft movement	During the shaft movement	After the shaft movement

Table 101: Display of the current position of the motor shaft in the Watch window

The following data concerning shaft movement is displayed in the Trace window:

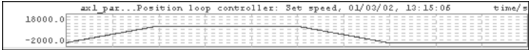
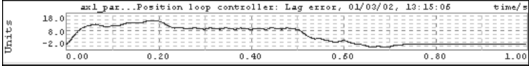
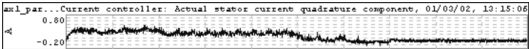
Set Speed
 The acceleration phase, the constant speed phase and the braking phase of the shaft movement can be evaluated here.
Lag Error
 - the lag error increases in the acceleration phase of the motor axis - the lag error remains constant at a constant speed - the lag error decreases in the braking phase
Actual stator current quadrature component
 The various movement phases are represented here: - in the acceleration phase of the motor axis: high current - at constant speed: current is reduced - in the braking phase: negative current

Table 102: Output of the recorded data in the Trace window

Chapter 7 • Standards and Certifications

1. Valid European Guidelines

- EMC guidelines 89/336/EWG
- Low-voltage guidelines 73/23/EWG
- Machine guidelines 98/37/EG

2. Valid Standards

Standard	Description
IEC/EN 61800-2	Adjustable speed electrical power drive systems • Part 2: General requirements; Rating specifications for low voltage adjustable frequency AC power drive systems
IEC/EN 61800-3	Adjustable speed electrical power drive systems • Part 3: EMC product standard including specific test methods
IEC 61800-5 (draft)	Adjustable speed electrical power drive systems • Part 5: Electrical, thermal and functional safety aspects; drive systems with electrically adjustable speed (IEC 22G/CD:1998)
IEC/EN 61131-2	Programmable logic controllers • Part 2: Equipment requirements and tests
IEC 60204-1	Safety of machinery - electrical equipment on machines • Part 1: General requirements
EN 1037	Safety of machinery - prevention of unexpected start-up
IEC 61508	Functional safety of electrical, electronic, programmable electronic systems
EN 954-1	Safety of machinery - safety-related parts of control systems • Part 1: General design principles ¹⁾
UL 508 C	Industrial control equipment • Part 6: Solid-state AC Motor Controllers

Table 103: Valid Standards for ACOPOS Servo Drives

1) TÜV: Sample test for secure restart inhibit according to EN 954-1 category 3 is in preparation.

The limit values specified from section 3 "Environmental Limits" to section 6 "Other Environmental Limit Values according to IEC 61800-2" are taken from product standard IEC 61800 for servo drives in industrial environments (2nd environment). Stricter test procedures and limit values are used during the type tests for ACOPOS servo drives. Additional information is available from B&R.

3. Environmental Limits

3.1 Mechanical Conditions according to IEC 61800-2

3.1.1 Operation

IEC 60721-3-3, class 3M1	
	IEC 61800-2
Vibration during operation $2 \leq f < 9$ Hz $9 \leq f < 200$ Hz	0.3 mm amplitude 1 m/s ² acceleration

Table 104: Mechanical conditions during operation

3.1.2 Transport

IEC 60721-3-2, class 2M1	
	IEC 61800-2
Vibration during transport $2 \leq f < 9$ Hz $9 \leq f < 200$ Hz $200 \leq f < 500$ Hz	3.5 mm amplitude 10 m/s ² acceleration 15 m/s ² acceleration

Table 105: Mechanical conditions during transport

3.2 Climate Conditions according to IEC 61800-2

3.2.1 Operation

IEC 60721-3-3, class 3K3	
	IEC 61800-2
Environmental temperature during operation	5 to 40 °C
Relative humidity during operation	5 - 85 %, non-condensing

Table 106: Climate conditions during operation

3.2.2 Storage

IEC 60721-3-1, class 1K4	
	IEC 61800-2
Storage temperature	-25 to +55 °C

Table 107: Climate conditions (temperature) during storage

IEC 60721-3-1, class 1K3	
	IEC 61800-2
Relative humidity during storage	5 - 95 %, non-condensing

Table 108: Climate conditions (humidity) during storage

3.2.3 Transport

IEC 60721-3-2, class 2K3	
	IEC 61800-2
Transport temperature	-25 to +70 °C
Humidity during transport	95 % at +40 °C

Table 109: Climate conditions during transport

4. Requirements for Immunity to Disturbances (EMC)

4.1 Evaluation Criteria (performance criteria)

Criteria A Test object not influenced during test.

Criteria B Test object only temporarily influenced during test.

Criteria C The system does not reboot automatically (reset required).

4.2 Low Frequency Disturbances according to IEC 61800-3

The following limits are valid for industry (2nd environment).

4.2.1 Power Mains Harmonics and Commutation Notches / Voltage Distortions

IEC 61000-2-4, class 3		
	IEC 61800-3	Performance Criteria
Harmonics	THD = 10 %	A
Short harmonics (< 15 s)	1.5x continuous level	B

Table 110: Limits for power mains harmonics

IEC 60146-1-1, class 3		
	IEC 61800-3	Performance Criteria
Commutation notches	Depth = 40 %, total area = 250 % x degree	A

Table 111: Limit values for commutation notches / voltage distortions

4.2.2 Voltage Changes, Deviations, Dips and Short-term Interruptions

IEC 61000-2-4, class 3		
	IEC 61800-3	Performance Criteria
Voltage changes and deviations	± 10 %	A
Voltage changes and deviations (< 1 min)	+10 % to -15 %	

Table 112: Limit values for voltage changes and deviations

IEC 61000-2-1		
	IEC 61800-3	Performance Criteria
Voltage dips and short-term interruptions	10 % to 100 %	C

Table 113: Limit values for voltage dips and short-term interruptions

4.2.3 Asymmetric Voltage und Frequency Changes

IEC 61000-2-4, class 3		
	IEC 61800-3	Performance Criteria
Asymmetric voltages	3 % negative component	A
Frequency change and change rate	$\pm 2\%$, 1 % / s (+4%, 2%/s if the power supply is isolated from general power mains)	

Table 114: Limit values for asymmetric voltages and frequency changes

4.3 High Frequency Disturbances according to IEC 61800-3

These immunity tests are valid for industrial environments (2nd environment).

4.3.1 Electrostatic Discharge

Tests according to IEC 61000-4-2		
	IEC 61800-3	Performance Criteria
Contact discharge to powder-coated and bare metal housing parts	6 kV	B
Discharge through the air to plastic housing parts	8 kV	

Table 115: Limits for electrical discharge

4.3.2 Electromagnetic Fields

Tests according to IEC 61000-4-3		
	IEC 61800-3	Performance Criteria
Housing, completely wired	80 MHz - 1 GHz, 10 V/m, 80 % amplitude modulation at 1 kHz	A

Table 116: Limits for electromagnetic fields

4.3.3 Burst

Tests according to IEC 61000-4-4		
	IEC 61800-3	Performance Criteria
Power connection	2 kV, 1 min, direct coupling	B
Lines for measurement and control functions in the process environment	2 kV, 1 min	
Signal interfaces, other lines	1 kV, 1 min	

Table 117: Limits for burst

4.3.4 Surge

Tests according to IEC 61000-4-5		
	IEC 61800-3	Performance Criteria
Power connection	1 kV ($2\ \Omega$) ¹⁾ , DM, symmetrical 2 kV ($12\ \Omega$) ¹⁾ , CM, unsymmetrical	B

Table 118: Limits for surge

1) The impedance was added from IEC 61000-4-5 because it is not defined in IEC 61800-3.

4.3.5 High Frequency Conducted Disturbances

Tests according to IEC 61000-4-6		
	IEC 61800-3	Performance Criteria
Power connection	0.15 - 80 MHz, 10 V, 80 % amplitude modulation at 1 kHz	A
Lines for measurement and control functions in the process environment		
Signal interfaces, other lines		

Table 119: Limits for conducted disturbances (radio frequency)

5. Requirements for Emissions (EMC)

5.1 High Frequency Emissions according to IEC 61800-3

These emissions tests are valid for industrial environments (2nd environment).

5.1.1 Emissions on the Power Connections

Tests according to IEC 55011			
Continuous Current on Motor	Frequency Range [MHz]	Quasi-peak Value	Average
$I \leq 100 \text{ A}$	$0,15 \leq f < 0,5$	100 dB (μV)	90 dB (μV)
	$0,5 \leq f < 5$	86 dB (μV)	76 dB (μV)
	$5 \leq f < 30$	90 dB (μV)	80 dB (μV)
$100 \text{ A} < I$	$0,15 \leq f < 0,5$	130 dB (μV)	120 dB (μV)
	$0,5 \leq f < 5$	125 dB (μV)	115 dB (μV)
	$5 \leq f < 30$	115 dB (μV)	105 dB (μV)

Table 120: Limits for emissions on the power connections

5.1.2 Electromagnetic Emissions

Tests according to IEC 55011	
Frequency Range [MHz]	Quasi-peak Value
$30 \leq f \leq 230$	40 dB (μV/m), measured at distance of 30 m ¹⁾
$230 < f \leq 1000$	50 dB (μV/m), measured at distance of 30 m ¹⁾

Table 121: Limits for electromagnetic emissions

1) The limit values were increased by 10 dB (μV/m) when measuring from distances of 10 m.

6. Other Environmental Limit Values according to IEC 61800-2

	IEC 61800-2
Degree of pollution according to IEC 61800-2, 4.1.2.1.	2
Over-voltage category according to IEC 60364-4-443:1999	II
Protection according to IEC 60529	IP20
Reduction of the continuous current at installation altitudes over 500 m above sea level	10 % per 1000 m
Maximum Installation Altitude	2000 m ¹⁾

Table 122: Additional environmental limits

1) Additional requirements are to be arranged with B&R.

7. International Certifications

B&R products and services comply with the applicable standards. They are international standards from organizations such as ISO, IEC and CENELEC, as well as national standards from organizations such as UL, CSA, FCC, VDE, ÖVE, etc. We give special consideration to the reliability of our products in an industrial environment.

Certifications	
USA and Canada 	All important B&R products are tested and listed by Underwriters Laboratories and are checked quarterly by a UL inspector. This mark is valid for the USA and Canada and eases certification of your machines and systems in these areas.
Europe 	All harmonized EN standards for the valid guidelines are met.
Russian Federation 	GOST-R certification is available for the export of all B&R ACOPOS servo drives in the Russian Federation.

Table 123: International Certifications

8. Standards, Definitions for Safety Techniques

Stop Functions according to IEC 60204-1/11.98 (electrical equipment for machines, part 1: general requirements)

The following three stop function categories exist:

Category	Description
0	Stop by immediately switching off the power to the machine drive elements (i.e. uncontrolled stop).
1	A controlled stop, the power to the machine drive elements remains on until the stop procedure is completed. The power is switched off after the stop is complete.
2	A controlled stop, the power to the machine drive elements is not switched off.

Table 124: Overview of stop function categories

The necessary stop functions must be determined based on a risk evaluation for the machine. Stop functions in category 0 and category 1 must be able to function regardless of the operating mode. A category 0 stop must have priority. Stop functions must have priority over assigned start functions. Resetting the stop function is not allowed to cause a dangerous state.

Emergency stops according to IEC 60204-1/11.98 (electrical equipment for machines, part 1: general requirements)

The following requirements are valid for emergency stops in addition to the requirements for the stop functions:

- It must have priority over all other functions and operations in all operating modes.
- The power to the machine drive elements which can cause a dangerous state must be switched off as quickly as possible without creating other dangers.
- Resetting is not allowed to cause a restart.

Emergency stops must be category 0 or category 1 stop functions. The necessary stop function must be determined based on a risk evaluation for the machine.

For emergency stop function in stop category 0, only hard wired, electromechanical equipment can be used. Additionally, the function is not allowed to depend on electronic switching logic (hardware or software) or the transfer of commands via a communication network or data connection.¹⁾

When using a category 1 stop function for the emergency stop function, it must be guaranteed that the power to the machine drive elements is completely switched off. These elements must be switched off using electromechanical equipment.¹⁾

¹⁾ In accordance to the national foreword for the valid German version of IEC 60204-1/11.98, it is determined that electronic equipment (and also especially for emergency stop systems) can be used regardless of the stop category, if e.g. it provides the same safety using the standards EN 954-1 and/or IEC 61508 as required by IEC 60204-1.

Safety category according to EN 954-1/03.97 (safety of machines - safety related parts of control systems, part 1: general design principles) ¹⁾

The safety related parts of control systems must meet one or more of the requirements for five defined safety categories. The safety categories define the required behavior of safety related controller parts regarding their resistance to errors.

Safety Category (according to EN 954-1)	Safety Integrity Level - SIL (according to IEC 61508-2)	Short Description	System Behavior
B	---	Safety related parts must be designed and built so that they can meet the expected operational requirements. (No specific safety measures are implemented.)	Caution! An error can cause the safety function to fail.
1	1	Safety related parts must be designed and built so that only reliable components and safety principles are used. (e.g. preventing short circuits by using sufficient distances, reducing the probability of errors by over-dimensioning components, defining the failure route - closed-circuit current principle, etc.)	Caution! An error can cause the safety function to fail.
2	1	Safety related parts must be designed so that their safety functions are checked in suitable intervals by the machine controller. (e.g. automatic or manual check during start-up)	Caution! An error between checks can cause the safety function to fail. If the safety function fails, it will be recognized during the check.
3	2	Safety related parts must be designed so that individual errors do not cause the safety function to fail. Individual errors should - if possible - be recognized the next time (or before) the safety function is required.	Caution! The safety function remains active when an error occurs. Some, but not all errors are recognized. A buildup of errors can cause the safety function to fail.
4	3	Safety related parts must be designed so that individual errors do not cause the safety function to fail. Individual errors must be recognized the next time (or before) the safety function is required. If this type of recognition is not possible, a buildup of errors is not allowed to cause the safety function to fail.	Information: The safety function remains active when an error occurs. Errors are recognized in time to prevent the safety function from failing.

Table 125: Safety category overview

Selecting the suitable safety category must be done separately for each ACOPOS servo drive (or for each shaft) based on a risk evaluation. This risk evaluation is a part of the total risk evaluation for the machine.

1) To prevent confusing EN 951-1 categories with IEC 60204-1 stop categories, the term "safety categories" was used in the text shown above for EN 954-1 categories.

The following risk graph (according to EN 954-1, Appendix B) provides a simplified procedure for risk evaluation:

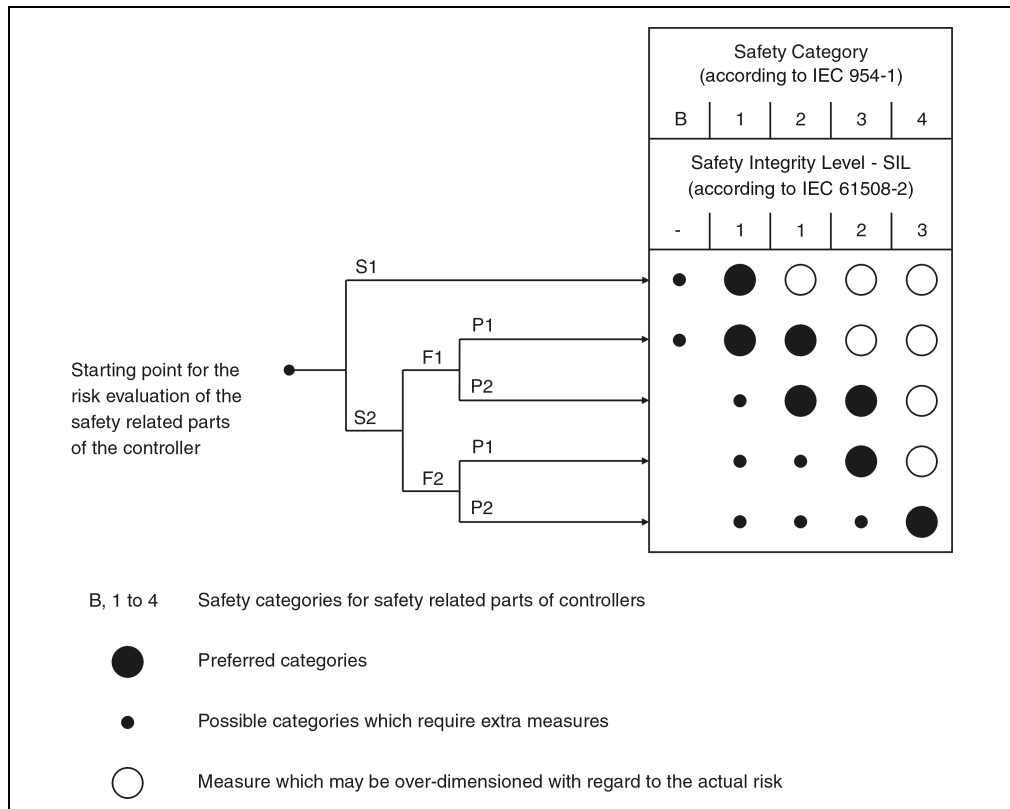


Figure 85: Risk graph according to EN 954-1, Appendix B

Begin at the starting point shown and follow the parameters S, F and P to the safety category to be used.

Parameter S ... Seriousness of injury	
S1	Light (usually reversible) injury.
S2	Serious (usually irreversible) injury.
Parameter F ... Frequency and/or duration of the danger exposure	
F1	Seldom to slightly more frequent and/or short exposure duration.
F2	Frequent to continuous and/or long exposure duration.
Parameter P ... Possibility to prevent danger	
P1	Possible under some conditions.
P2	Nearly impossible.

Table 126: Parameters S, F and P lead you to the safety category to be used

Restart inhibit according to EN 1037/04.96 (Safety of machinery - prevention of unexpected start-up)

Keeping a machine in an idle state when people are working in the danger zone is one of the most important requirements for safe operation of machines.

Starting refers to the transition of a machine or its parts from an idle state to moving state. Any start is unexpected if it is caused by:

- A start command sent because of a controller failure or because of external influences on the controller.
- A start command sent because of incorrect operation of a start element or another part of the machine.
- Restoration of power supply after an interruption.
- External/internal influences on parts of the machine.

To prevent unexpected starting of machines or parts of machines, power should be removed and dissipated. If this is not practical (e.g. frequent, short work in danger zone), other measures must be taken:

- Measures to prevent random start commands.
- Measures to prevent that random start commands cause unexpected starting.
- Measures to automatically stop dangerous parts of the machine before a dangerous situation can be caused by unexpected starting.

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